THE Journal
OF THE AMERICAN DENTAL ASSOCIATION

MAY
1952

CONTENTS

Salivary radiophosphorus in enamel and dentin—Sognnaes. . 489
Mouth breathing—Emslie 506
Dynamic models for patient education—Simring 522
Fundamental research on beginning caries—Nuckolls 529
Roentgen ray diffraction of enamel—Frankel 542
Cases and comments 553
Reports of councils 556
Editorials 563
The reader comments 567
Washington news letter 569
News of dentistry 571
Book reviews 589
Current literature 597
Deaths 609
Directory 612
Announcements 614

NINETY-THIRD ANNUAL SESSION

VOLUME 44
NUMBER 5

ST. LOUIS, MO.—SEPT. 8-11

WHY IS THE THREE DIMENSIONAL ASPECT OF THE TRUBYTE BIOFORM SYSTEM IMPORTANT IN TOOTH SELECTION?

THE DENTISTS' SUPPLY COMPANY OF NEW YORK

Safe! with DEE GOLD

Yes, you're SAFE when using DEE GOLD . . . because the years of metallurgical research enables DEE GOLDS to have the right physical properties for each specific use in dentistry. SAFE . . . because of the unvarying uniformity found in each composition. SAFE . . . because you know your patient will be satisfied.

Write for this DEE GOLD folder. It gives the melting range, physical properties, and suggested uses of the different alloys.

BE SAFE . . . USE DEE GOLD

PRECIOUS METALS • DENTAL SPECIALTIES • REFINING •
DEE GOLD

HANDY & HARMAN

DEE PRODUCTS GENERAL OFFICES & PLANT
1900 WEST KINZIE STREET • CHICAGO 22, ILL.
TORONTO 2B, ONTARIO, 141 JOHN ST. • LOS ANGELES 63, CALIF., 3425 MEDFORD ST.

RAPID onset...
COMFORTABLE tolerance...
ADEQUATE anesthesia...
for prolonged procedures or relief of post-operative discomfort following surgery
Order a supply of Novocain-Pontocaine-Cobefrin today and you'll see why
REMEMBER — do not confuse rapid injection with speed of anesthesia. Inject slowly and gently for best results.
npc
Carpule
COOK-WAITE Laboratories, Inc
1450 BROADWAY, NEW YORK 18, N. Y.
Cobefrin, Novocain, Pontocaine, Trademarks (Reg. U.S. Pat. Off. and Canada) Winthrop-Stearns Inc.

IT WAS A BRIGHT EARLY DECEMBER DAY and Lieutenant Hudner was flying a Korean combat mission alongside another plane piloted by Ensign Jesse Brown. A burst of flak caught the ensign's plane and he went spinning down, aflame. Despite the presence of enemy ground troops, Lieutenant Hudner then deliberately crash landed near his flame-trapped shipmate. He radioed for help, after which he fought to keep the fire away from the fatally injured ensign until a rescue helicopter arrived. Today Lieutenant Hudner has something to say to you:

"Maybe if America had been strong enough to discourage aggression two years ago, my friend, Jesse Brown, might be alive right now. So might thousands more of our Korea dead.

"For it's only too sadly true—today, in our world, weakness invites attack. And *peace is only for the strong.*

"Our present armed forces *are* strong—and growing stronger. But don't turn back the clock! Do your part toward *keeping* America's guard up by buying more . . . and more . . . and more United States Defense Bonds *now!* Back us up. And *together* we'll build the strong peace that all Americans desire!" *Peace is for the strong! Buy U. S. Defense Bonds now!*

★ ★ ★

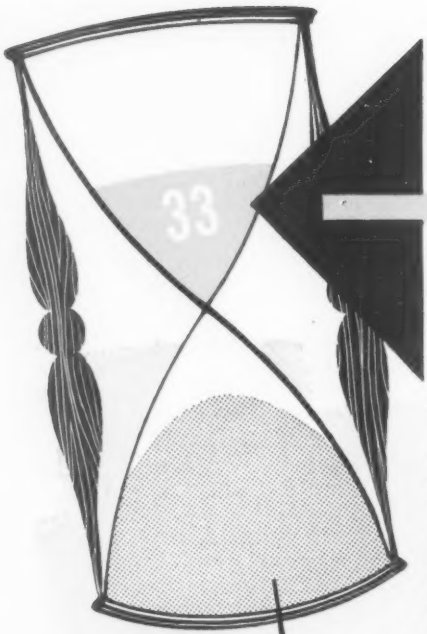
Remember that when you're buying bonds for defense, you're also building a reserve of savings. Remember, too, that if you don't save *regularly*, you generally don't save at all. So sign up today in the Payroll Savings Plan where you work, or the Bond-A-Month Plan where you bank. For your country's security, and your own, buy U. S. Defense Bonds now!

Lieutenant (jg)
Thomas Hudner, Jr.
U.S.N.

Medal
of Honor

The U. S. Government does not pay for this advertisement. It is donated by this publication in cooperation with the Advertising Council and the Magazine Publishers of America.

The Journal of the American Dental Association, Vol. 44, No. 5. Published by the American Dental Association, 222 E. Superior St., Chicago 11, Ill. Yearly subscription $7.00 for U. S. and possessions; $8.00 for foreign countries. Single copy seventy-five cents. Entered as second-class matter, December 31, 1947, at the postoffice at Chicago, Ill., under the act of March 3, 1879. Published monthly. Copyright 1952 by the American Dental Association. The Journal of the American Dental Association is indexed in the Index to Dental Literature, in the Current List of Medical Literature and, in part, in the quarterly Cumulative Index Medicus, Biological Abstracts and Chemical Abstracts.



Only 33 GOLDEN HOURS

PER WEEK! USE THEM PROFITABLY!

Yes, 33 hours a week for 46 weeks a year is all a dentist can do *at the chair* without a loss of efficiency, states a British report.

Just 33 golden hours of productive time to do all the income-producing work you are going to do in a week without tension — nervous strain!

Make the most of these golden hours and avoid night-after-night work and those skipped vacations. Learn how PBP practice management gives you more efficiency, more production and more income—yet you do the kind of work you have always wanted to do.

Get your free brochure

PBP's large, dynamic, factual brochure—*Destination: SUCCESS in Your Dental Practice* — takes you, step by step, through an explanation of how PBP can help you get: (1) more efficiency, (2) more production, (3) more income, (4) more good will, (5) more leisure. Send for your FREE copy of the brochure TODAY. See how you get MORE out of your 33 golden hours with PBP in your practice!

A NATIONAL ORGANIZATION
PBP
MADISON, WISCONSIN

THIS OFFICE IS ASSOCIATED WITH THE
PROFESSIONAL BUDGET PLAN

PROFESSIONAL BUDGET PLAN
303 E. Wilson Street, Madison 3, Wisconsin

Please send me the brochure,
Destination: SUCCESS in Your Dental Practice

Dr.....

Street.....

City.....Zone.....State.....

. . . SO RIGHT FOR YOUR PATIENT

"Lightness" is thinness and fit. Because NEY-ORO G-3 is so strong, partials can be made thinner and clasps more delicate. G-3 casts with the fit of an inlay but packs twice the strength of structural steel.

The finest gold alloy, G-3 gives your patient the promise of unexcelled beauty in form and finish along with comfortable "lightness." A Ney Technical Book, "Planned Partials," is available by writing The J. M. Ney Company, Hartford 1, Connecticut.

Your
PLANNED PARTIALS
IN NEY-ORO G-3

The J. M. NEY COMPANY
Dependable Products . . . Helpful Service
Since 1812

THE MODERN ANESTHETIC

PROCAINE HC1 2%
TETRACAINE HC1 .15%
PHENYLEPHRINE HC1 1:2500

ONE OF **Graham's 7 Anesthetics**

Accepted COUNCIL ON DENTAL THERAPEUTICS AMERICAN DENTAL ASSOCIATION

Cat. #	
PT25	PROCAINE HCl 2% — TETRACAINE HCl .15% with Phenylephrine HCl 1:2500
65	PROCAINE HCl 4% with Epinephrine 1:65,000
NS	PROCAINE HCl 4% with Phenylephrine HCl 1:2500
50	PROCAINE HCl 2% with Epinephrine 1:50,000
2NS	PROCAINE HCl 2% with Phenylephrine HCl 1:2500
25	PROCAINE HCl 2% with Epinephrine 1:25,000
0	PROCAINE HCl 2% Plain

All Graham cartridges are metal-capped to prevent leakage, and vacuum-packed to assure freshness. You will find Graham Anesthetics at leading dealers.

PROFOUND

The combination of Procaine-Tetracaine-Phenylephrine (Graham Catalog #PT25) provides a modern anesthetic which provides anesthesia of unusual density. It has a fairly long period of analgesia—a period which may last for many hours.

Procaine-Tetracaine-Phenylephrine has a wide range of uses, but is indicated in those cases where anesthesia is difficult to obtain. Because of its profundity, a smaller than normal amount of solution may be used in many cases.

ECONOMICAL

Because of its profundity, a smaller amount of this anesthetic is indicated for most dental preparations. This makes it possible to market this anesthetic in the 1.8 cc size cartridge, and permits the use of a shorter syringe, thus making the manipulation of the syringe easier for the dentist.

SAFE

Phenylephrine HCl is the vaso-constrictor used in combination with Procaine and Tetracaine. This well-known and widely used vaso-constrictor in many cases is better tolerated in certain types of cardio-vascular diseases than is Epinephrine. Bleeding is well controlled and as a result healing is usually uneventful.

Graham Chemical Co.

SPRINGFIELD GARDENS, N. Y.

ICE CREAM— a nourishing food and so good to eat

A favorite food for all ages

For oldsters and youngsters—ice cream offers many essential nutrients in a palatable and "easy-to-eat" form.

Surveys show that when people tend to decrease their food intake as they grow older, they often do so by omitting foods hard to prepare or eat. While a reduction in calories may be advantageous, there also may be an undesirable reduction in the intake of certain nutrients—particularly calcium and protein.[1]

Ice cream supplies calcium and high-quality protein, and other important nutrients apt to be lacking in limited diets. It is an excellent food for older people, for ice cream tastes good, is easy to eat, is highly digestible, and its nutrients are readily available to the body.

For the same reasons, ice cream is a good food for children, too. Children love ice cream—and frequent and continued use does not decrease its popularity. This was clearly demonstrated in a study in a boarding school, in which this food was served at least twice a week for more than a year. It was eaten with unfailing enthusiasm. Directors of the project stated that ice cream was "psychologically a great boon . . . helped lend tone to the project as nothing else could."[2]

High nutritive value plus delicious flavor—the combination makes ice cream a favorite food for all.

1. Ohlson, M. A., Roberts, P. H., Joseph, S. A., and Nelson, P. M. *Dietary practices of 100 women from 40 to 75 years of age.* J. Am. Diet. Assn. *24*:286 (April) 1948.

2. Roberts, L. J., Blair, R., and Greider, M. *Results of providing a liberally adequate diet to children in an institution. I. Acceptance of foods and changes in the adequacy of diets consumed.* J. Pediatrics *27*:393 (Nov.) 1945.

The presence of this seal indicates that all nutrition statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

National DAIRY COUNCIL
111 N. Canal Street, Chicago 6, Illinois

Since 1915 . . . the National Dairy Council, a non-profit organization, has been devoted to nutrition research and education to extend the use of dairy products.

first

means "original, before all others" . . .

FR X-Ray solutions were first in concentrated liquid form (more than 15 years ago). And through continuing research and improvement have maintained their years-ahead advantages.

first

means "finest, better than all others" . . .

FR Concentrated Liquid X-Ray Solutions have proven their superiority in quality . . . accuracy . . . clarity . . . diagnostic detail in dental and hospital darkrooms all over America.

first

means "safety, dependability" . . .

That's why FR Concentrated Liquid X-Ray Solutions are first in your dental darkroom.

In every way

fR

KERR MFG. CO.
Exclusive distributors to the dental field for

CONCENTRATED LIQUID
X-RAY SOLUTIONS
Were, are, always will be FIRST!

FREE: X-ray Developing Guide. Write to Dept. A

THE FR CORPORATION • 951 BROOK AVE. • NEW YORK 56, N.Y.

A Choice of Three

POSTURE COMFORT CHAIRS

MODEL 1050

MODEL 1050A

MODEL 135

Send for FREE Booklet

The Model 1050 Posture Comfort Chair is a standard model used by the majority of dentists. Model 1050-A is the same as Model 1050 except that the saddle seat affords greater leg room comfort for the tall slender dentist — Supplied only on special order. Model 135 is the same as Model 1050 without the lateral body support. *Take your choice* — Select the model that suits you best. Now you can operate in the seated position with complete mobility . . . confidence and comfort. Order from your dealer today or write:

CHILDS MANUFACTURING COMPANY

Macon, Georgia

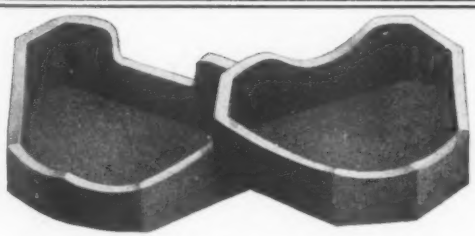
THE
MEDICAL
PROTECTIVE
COMPANY
FORT WAYNE,
INDIANA
•
PROFESSIONAL PROTECTION
EXCLUSIVELY
SINCE 1899
specialized service
assures "know-how"

ELIMINATE
GUESSWORK!
USE THE
Deluxe
DENTAL
MIX
PRICE ONLY
$39.75

An automatically operated mortar and pestle which gives you positive control of trituration . . . Assures consistently uniform amalgam batches . . . in 10 SECONDS. Good looking . . . practically noiseless 110-120 V. 60 cycle AC only

- Patented principle in mortar and pestle
- Fingertip power control
- Stroke adjustment
- Accurate Timer built-in
- Convenient to use
- Three year guarantee

M DeLuxe A
Master APPLIANCE MFG. CO.
RACINE WISCONSIN



By
Popular
Demand

JUMBO-SIZED COLUMBIA RUBBER MODEL FORMERS
Make Neat Bases on Study and Work Models

per Set—1 Upper and 1 Lower
No. R1X—Jumbo-Size....$4.00
Other Sizes Available
No. R1—Large..... 3.50
No. R2—Medium..... 3.50
No. R3—Small..... 3.00

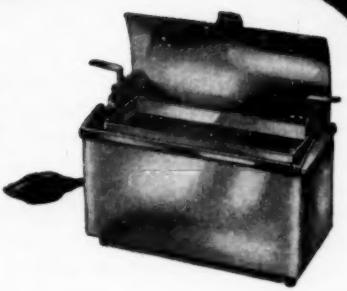
These Extra Large Model Formers speed up making symmetrical bases for study and work models of extra large impressions. They eliminate boxing-up, fussing and trimming. Just the thing for models of alginate impressions, which run notoriously large. Base comes out of the flexible rubber former smooth, symmetrical, and perfectly finished.
Complete instructions with every set.

Have You a Copy of Catalog No. 33?
COLUMBIA DENTOFORM CORPORATION
"The House of A Thousand Models"—also Headquarters for Brown Precision Attachments
131 EAST 23rd STREET NEW YORK 10, N. Y.

Meet the
8-INCH STERILIZER TWINS!

I am Model 8-0 . . .

a mighty handy and efficient unit that both sterilizes and lubricates with HOT OIL. You will find me unexcelled for dental handpieces, contra-angles, forceps, burrs, chisels, mirrors and the many allied instruments that are subject to rust or corrosive damage if repeatedly exposed to boiling water.



I am Model 8 . . .

a compact and dependable BOILING WATER sterilizer especially suitable for syringes, needles and the many steel surgical instruments the efficiency of which are not impaired by repeated exposure in the medium of boiling water.

Model 8 is ideal for the private home where sterilization of hypodermic syringes and needles employed in the treatment of diabetes and other conditions is required.

TWIN CHARACTERISTICS

- Chamber dimensions 2⅛ x 3¼ x 9 inches.
- Fabricated of cast bronze, stainless steel and Monel metal, with Fenwal precision thermostatic control unit for accurate temperature maintenance.
- Constructed to permit cover to open full 90° and automatic lifting of instrument tray which may be easily and firmly secured for draining.

Ask your dealer or write us for further information

AMERICAN STERILIZER COMPANY

Erie, Pennsylvania

NEW, SECOND EDITION

Oral Medicine

DIAGNOSIS AND TREATMENT

by LESTER W. BURKET, B.S., D.D.S., M.D., SC.D., *Professor of Oral Medicine and Dean, School of Dentistry, University of Pennsylvania; Professor of Oral Medicine, Graduate School of Medicine, University of Pennsylvania; Honorary Professor, National University Bogota, Colombia; Chief, Oral Medicine Service, Philadelphia General Hospital; Consultant to the Army, Navy and Veterans Administration.*

The completely revised and reset second edition incorporates the many recent advances in the field of oral medicine. Particular emphasis is directed to the practical technics of oral diagnosis and treatment and to everyday medicine as it relates to the practice of dentistry.

An important new section on oral cancer is contributed by Dr. S. Gordon Castigliano, in which it is pointed out that the practitioner often has the first opportunity to recognize this disease, regardless of who may subsequently treat it.

A color atlas of 40 subjects on 10 plates illustrates the oral lesions most commonly encountered by the dentist. The color plates are so arranged that they can be used readily with the Diagnostic Index which follows.

A new approach to focal infection is presented. Dental pediatrics, gerodontics, hazards of dental practice, and dental diseases of occupational origin are a few of the many subjects discussed.

The original edition of this work has been well received. Now, redesigned in a new 7″ x 10″ format, the second edition provides better display for the illustrative material and has permitted enlargement of many of the 372 Illustrations.

600 Pages. *372 Illustrations, 10 Color Plates.* *$14.00*

LIPPINCOTT BOOKS

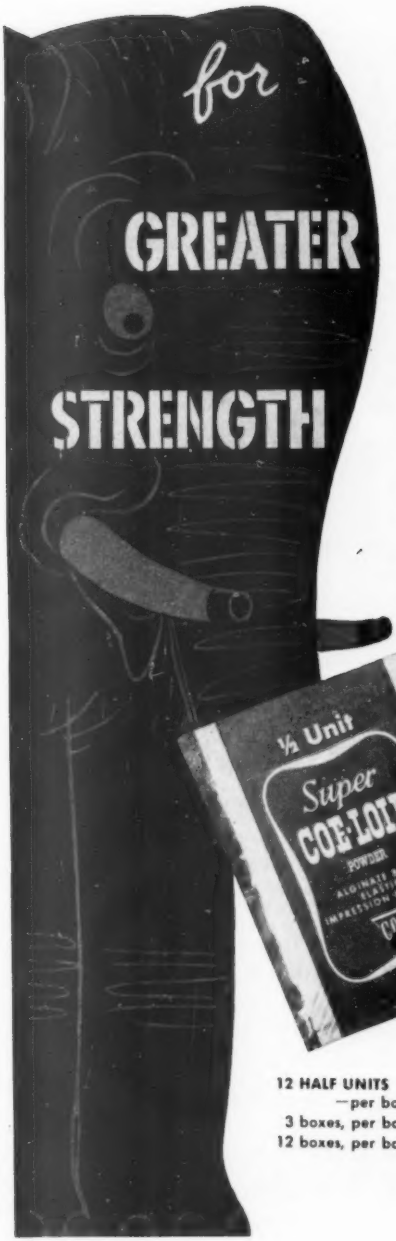
J. B. LIPPINCOTT COMPANY, East Washington Square, Philadelphia 5, Pa.

Please send me:_____copies of Burket, ORAL MEDICINE $14.00

Name_____ ☐ Cash Enclosed

Address_____ ☐ Charge My Account

City, Zone, State_____



Super **COE-LOID**, as its name suggests, has *all* of the qualities of popular Coe-Loid Powder impression material plus greatly increased STRENGTH. This trouble-free, alginate-base hydrocolloid is actually super in every way: gets a dimensionally accurate impression of teeth and tissue for single tooth restorations, partials, or static full dentures. It's easy to use; requires no special equipment. And for your convenience, SUPER COE-LOID POWDER is now available in Half Units for impressions of bridges, inlays, etc., and Full Units for partials and full dentures. Packaged 12 Half Unit envelopes, or 12 Full Unit envelopes to carton. 12 Half Units only $2.25; 12 Full Units only $4.00. Save time at the chair, save material, save money. Buy Super Coe-Loid.

COE LABORATORIES, INC., CHICAGO 21, ILL.

Order from your dealer

12 HALF UNITS		12 FULL UNITS	
—per box	$2.25	—per box	$4.00
3 boxes, per box	2.10	3 boxes, per box	3.75
12 boxes, per box	2.00	12 boxes, per box	3.50

STOP Testing Tooth Vitality with ELECTRIC S-H-O-C-K!

USE BURTON RADIONIC *new* HIGH FREQUENCY VITALOMETER

Replace that OBSOLETE "Pulp Tester" on Your Unit Today

Play safe Doctor. If you still have an old "electric shocking pulp tester" on your unit . . . or some other so-called "pulp tester" . . . replace it with Burton's **Radionic** HIGH FREQUENCY VITALOMETER — the most modern and newest modality that is safe, sure and accurate every time. Can be installed on all modern dental units.

NO. 205 HIGH FREQUENCY VITALOMETER SET, $65.00

NO. 287 COMPLETE DIAGNOSTIC SET

No. 287 Complete Burton diagnostic set including the high frequency Vitalometer, Transilluminators and other diagnostic, operative and examining aids, only $85.50.

SEE THEM AT YOUR DEALER OR WRITE

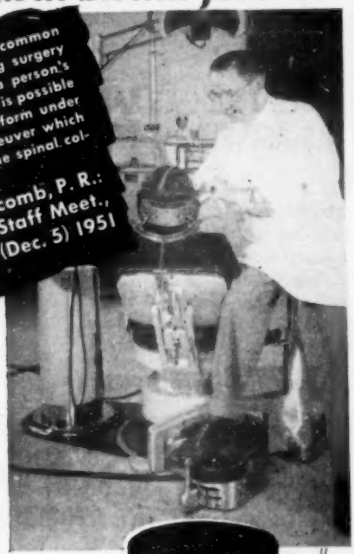
FREE TO DENTISTS: Send for Burton's Educational Treatises

BURTON MANUFACTURING COMPANY
11201 WEST PICO BOULEVARD • LOS ANGELES 64, CALIF.

You can't fight Postural Strain forever

It has been pointed out that postural strain is common to several occupations, among them being surgery and dentistry. If backache is caused by a person's leaning over while doing his work, it often is possible to relieve it by placing a stool on a platform under one foot. This elevates one foot, a maneuver which tends to straighten the lumbar part of the spinal column, and thus to relieve the strain.

Abstracted from: Lipscomb, P. R.: Postural Backache, Proc. Staff Meet., MAYO CLINIC 26:472-473 (Dec. 5) 1951



End Postural Strain, Needless Fatigue and Resulting Incapacity or Deformity

Join the thousands of far sighted dentists who are protecting their future with modern "Sit down dentistry" . . . with Rota-Seats, the professionally designed unit that permits a dentist to assume every natural operating position while comfortably seated . . . permits effortless shifting from one position to any other . . . permits wide lateral movement in toward the patient or out, entirely free of the patient . . . permits change from sitting to standing position without raising or lowering patient, lights, etc. (an exclusive Rota-Seat feature) . . . that provides, whether standing or sitting, a foot platform or rail, so necessary to relieve postural strain. The new Rota-Seat can be operated with or without a rubber mat.

JOHNSON CRADLE

Sitting or standing the new Johnson Cradle head rest, (illustrated above) allows patient's head positioning for easy access to all quadrants of the mouth.

ROTATES

Entire Unit rotates over 180° around chair on four rubber rollers. Will operate on rubber mat.

SLIDES

Seat slides in or out, on roller bearings. Tilt-Lock holds position without bracing. Can be procured for DeLuxe Models now in use.

RELAXES

Raised platform foot control and near-floor rail foot rest assure relaxed position whether sitting or standing.

Note low step-over radial arm on new Model 125. Especially designed for hygienists.

Write for illustrated Rota-Seat Bulletin "How to Combat Fatigue and Live Longer."

Rota-seat INC.

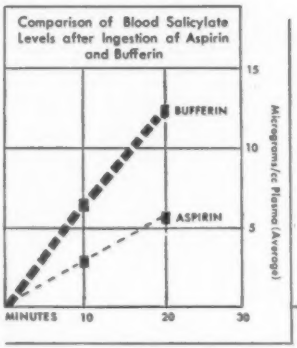
Dental Equipment Specialists

4606 W. 21st St. • Cicero 50, Illinois

Faster Pain Relief with BUFFERIN

1 ACTS TWICE AS FAST AS ASPIRIN

The antacids in Bufferin speed its pain-relieving ingredients through the stomach and into the blood stream. Actual chemical determinations show that within ten minutes after Bufferin is ingested blood salicylate levels are higher than those attained by aspirin in twice this time.[1]



2 DOES NOT UPSET THE STOMACH

Bufferin's antacid ingredients protect the stomach against aspirin irritation. This has been clinically demonstrated on hundreds of patients.

in usual doses

In a series of 238 cases, 22 had a history of gastric distress due to aspirin but only one reported any distress after taking 2 Bufferin tablets (equivalent to 10 grains of aspirin).[1]

in large doses

In a recent study group, 1006 patients received, over a 24 hour period, 12 Bufferin tablets (equivalent to 60 grains of aspirin). Although 72 had a history of being sensitive to aspirin, only 18 reported any gastric side-effect with Bufferin.[2]

1. Effect of Buffering Agents on Absorption of Acetylsalicylic Acid. J. Am. Pharm. Assoc., Sc. Ed. 39:21. Jan. 1950
2. Gastric Tolerance for Aspirin and Buffered Aspirin. Ind. Med. 20:480. Oct. 1951

INDICATIONS: Simple headaches, neuralgias, dysmenorrhea, muscular aches and pains, discomfort of colds and minor injuries. Particularly useful when gastric hyperacidity is a complication. Useful for relieving pain in the treatment of arthritis. Helpful for toothaches and pain following tooth extraction.

EACH BUFFERIN TABLET contains 5 grains of acetylsalicylic acid, together with optimum amounts of the antacids aluminum glycinate and magnesium carbonate.

AVAILABLE in vials of 12 and 36 tablets and in bottles of 100. Tablets scored for divided dosage.

BUFFERIN is a trade-mark of the Bristol-Myers Company.
Bristol-Myers Co., 19 West 50 St., New York 20, N. Y.

MAY 1952 VOLUME 44 • NUMBER 5

THE Journal OF THE AMERICAN DENTAL ASSOCIATION

Salivary and pulpal contributions to the radiophosphorus uptake in enamel and dentin

Reidar F. Sognnaes, D.M.D., Ph.D., and James H. Shaw,† Ph.D., Boston*

Clinical observations suggest that the teeth deteriorate quickly after the major salivary glands are removed or destroyed, whereas teeth can function satisfactorily following pulp removal and root filling. Such observations cannot be fully explained until more is known about the exact physiologic interactions of the saliva, the enamel and dentin, and the internal blood supply of the teeth. In addition to explaining such comparatively extreme conditions, it is believed that further knowledge of this relationship may shed light on some of the factors involved in the initiation and prevention of dental caries.

Opportunities to study this problem have been increased by the introduction of the radiotracer technics, prior to which it had been extremely difficult to detect changes in the enamel of adult teeth. In previous work, when cyclotron-made radiophosphorus (P^{32}) was fed to cats and dogs as a tracer, the surface enamel has been reported to attain an elevated radioactivity, which could be significantly reduced when salivary access to the tooth surface was experimentally prevented by capping the teeth.[1] Tentatively these results were interpreted to indicate that the P^{32} uptake of the enamel surface largely depended on the adsorption of P^{32} secreted through the saliva. On the other hand, it could be argued that such an experimental procedure, besides preventing contact with the P^{32} in the oral fluids, also disturbed the normal physiologic relationship between the enamel

Prize winning essay read before the Midwinter Meeting of the Chicago Dental Society, February 6, 1952.

This project was supported in part by a contract with the Atomic Energy Commission.

*Associate professor of dental medicine, Harvard School of Dental Medicine.

†Assistant professor of dental medicine, Harvard School of Dental Medicine.

1. Sognnaes, R. F., and Volker, J. F. Studies on the distribution of radioactive phosphorus in the tooth enamel of experimental animals. Am. J. Physiol. 133:112 (May) 1941.

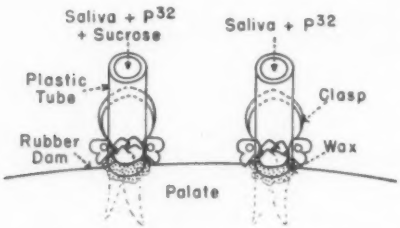


Fig. 1 • Procedure used in short term experiments for isolation of the crowns of bilaterally symmetrical teeth

and the saliva *per se*, irrespective of salivary radioactivity. Furthermore, and in contrast to these findings, it was reported simultaneously[2] that the radioactivity of the enamel in P^{32}-fed dogs was not reduced materially when the teeth were capped, the inference being that salivary P^{32} did not contribute to the uptake in the enamel.

These earlier observations were obtained in cats and dogs whose enamel is believed to be more permeable than that of primate teeth. Furthermore, earlier studies were limited by the fact that the P^{32} dosage was relatively small; hence, the radioactivity of the enamel samples was comparatively low, both in the control and in the experimental animals. For these reasons it was decided to re-examine this problem in a higher species of experimental animal, at a higher level of radioactivity and with the greater variety of technical procedures for sample preparation which have become available during the previous decade.

MATERIALS AND METHODS

The physical facilities for this investigation consisted of three rooms designed to cover all the various phases of radioisotope studies in relatively large experimental animals (monkeys) : one room for housing of the radioisotope-injected animals, one for the performance of short-term experiments and sample preparation, and one for determination of tissue radioactivity.

In preference to cats and dogs, rhesus monkeys were selected for experimental animals because their teeth are more comparable to those of man with regard to size, shape, structure and, presumably, with respect to physiologic characteristics. The present report is based on observations in 23 monkeys of an average weight of about 3,500 Gm. The P^{32} distribution in the dental tissues was compared in intact versus desalivated animals, in intact versus root-filled teeth, and in vital versus nonvital (extracted) teeth.

In the majority of experiments to be reported in this study, intravenous administration of relatively large dosages of P^{32} was employed, an average of 10 millicuries. These experiments were conducted for periods which varied from 5 to 216 hours.

In the rest of the experiments, the P^{32} exposure was limited to the external surfaces of teeth which were isolated from direct contact with the oral fluids, as outlined in Figure 1. This experimental procedure was so designed that the external surfaces of the teeth could be exposed either to nonradioactive saliva, to biologically or artificially radioactivated saliva, or to saliva modified in other ways. This procedure had to be limited to short term experiments (5 to 24 hours) in anesthetized animals. With the tracheotomized monkey placed on its back, the cheeks slit open, and the jaws in a wide open position, the crowns of the maxillary first permanent molars were isolated by means of a rubber dam held in place with rubber dam clamps. Next, soft plastic tubes, 2 cm. long and 1 cm. wide, were sealed at the neck of the teeth by means of sticky dental wax.

2. Wassermann, F., and others. Studies on the different pathways of exchange of minerals in teeth with the aid of radioactive phosphorus. J.D. Res. 20:389 (Oct.) 1941.

Within these tubes various saliva mixtures (0.5 to 1 ml.) were placed in contact with the tooth surface. In all instances, a crystal of thymol was added to each mixture to prevent bacterial activity.

At the termination of the experimental periods, samples of blood were taken from the ear for hematologic examination and a large sample of heart blood was collected for radioactivity determinations. In the long term experiments, the monkeys were sacrificed by severing the jugular veins during deep anesthesia; in the short term experiments, the monkeys were killed by clamping the trachea with a hemostat. During the removal of the teeth and jaws, extreme precautions were taken to prevent any contact of tooth surfaces with body fluids. Thus, in the short term experiments the jaw segments were sawed off with the rubber dam still in place in order to protect the tooth surfaces. After removal, the teeth were scrubbed thoroughly and repeatedly with small bristle brushes under rapidly running water to remove any adherent deposits. The teeth to be used for gravimetric separation, grinding or segmentation were dried for several hours at 38° C. and then sampled by the various procedures which will be described later. Jaw segments and teeth to be used for the preparation of radioautographs were fixed and dehydrated in dioxane immediately after their removal from the animal.

Procedures in Sample Preparation • Several technical problems are involved in connection with sample preparation of the highly calcified dental tissues. The following four procedures were used successfully and were found to complement each other:

Gravimetric Separation • Samples of whole enamel and dentin were obtained by the so-called flotation-centrifugation method.[3] This procedure consists in powdering the teeth and then gravimetrically separating the highly calcified enamel powder, the density of which is nearly 3.00, from the dentin which has a specific gravity nearer 2.0. Bromoform, the density of which falls in betweeen (2.85) and which can be decreased further by addition of chloroform, served as the fluid for the separation of the two tissues. Whenever the size of the samples permitted, the enamel powder was further divided into different density fractions containing the lesser calcified (density 2.60 to 2.85) and the more highly calcified portions (density over 2.85). It appeared possible that adsorption of radioisotope (in this case P^{32}) from dentin to enamel powder might occur when mixed in the bromoform solution during the separation procedure. Hence, tests were performed by the thorough mixing together of nonradioactive enamel powder with dentin powder into which a high level of P^{32} had been incorporated *in vivo*. After separation of the two by the afore-mentioned procedure, it was possible to demonstrate that no transfer of the P^{32} from the biologically radioactive dentin to the enamel occurred during the bromoform treatment. Consequently, the suspension of enamel and dentin in bromoform did not present a problem insofar as contamination of the enamel was concerned.

Surface Grinding • A difficult but important and profitable technic was developed for preparation of samples of the external enamel surface and underlying layers of enamel and dentin. This method is similar to one used in a previously mentioned study,[1] but was modified for more exact sampling and for safer handling of the higher levels of radioactivity involved in the present investigation. For this purpose, the crowns of teeth were firmly attached with sticky wax to the bottom of small, hollow, plastic or, preferably, glass

3. Manly, R. S., and Hodge, H. C. Density and refractive index studies of dental hard tissues. I. Methods for separation and determination of purity. J.D. Res. 18:133 (April) 1939.

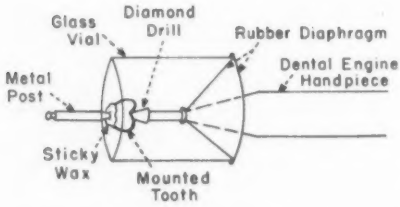


Fig. 2 • Device used for layer by layer removal of tooth samples by means of diamond stone grinding

cylinders, 2.5 cm. wide and 3.8 cm. long (Fig. 2). The open end of the cylinders was fitted with a readily removable rubber shield finger cot or facsimile to prevent loss of the grindings. Using a dental engine with a straight handpiece, diamond drills were introduced into the cylinder through a small, central hole in the rubber diaphragm and placed in contact with the tooth surface. With repeated changes of the drills and constant observation through a binocular microscope, it was possible to remove and collect finely powdered samples of successive layers of enamel (Fig. 3); subsequently layers of the underlying dentin were removed by the same procedure except that the diamond drills were replaced by steel burs. The powder of each successive layer collected within the walls of the tube was transferred in appropriate quantities to sample cups, weighed and counted. Samples of 3 mg. or more were obtained readily for each layer.

Radioautography • For this purpose, previously described histologic technics were used.[4,5] Segments of jaws and individual teeth were embedded in a hard plastic material (methyl methacrylate), cut into thin sections by rapidly rotating jeweler's slotting saws and attached to plastic slides (Plexiglass) with a plastic cement (Plexiglue). In almost all instances in this study, sufficiently thin sections for radioautography could be cut directly with the saw; when necessary, these sections were ground further on rotating grinding wheels. The relative radioactivity of each section was next appraised as a guide to the exposure time required; then individual sections were placed in contact with the emulsion on a photographic film for exposure in the usual manner. After development and fixation, the P^{32} distribution could be compared in hard, semihard and soft structures (Fig. 4, A) and correlated with the P^{32} counts expressed on a unit weight basis.

Segmentation • Sections prepared as described were further processed for two special purposes: (1) where radioautographs showed the coexistence of tissue areas of both relatively low and relatively high radioactivity within the same section, it proved valuable to remove the areas of high level activity by means of dental burs and then prepare radioautographs of the remaining low activity areas by prolonging the exposure time (Fig. 4, B); (2) by similar removal of parts of the sections, carefully selected segments of enamel and dentin from various areas of the teeth were segregated, weighed, dissolved in acid, dried and counted on a unit weight basis.

Counting Procedure • A lead-shielded TGC-2 Geiger-Müller tube with a window of 1.8 mg. per square centimeter was used with a Tracerlab Autoscaler for the radioactivity determinations throughout this entire investigation. The geometry of this counting system for P^{32} was 31 per cent. Therefore, to convert the relative values of radioactivity as recorded in this paper to actual disintegrations per minute, the values may be multiplied by 3.2 ($\frac{1}{0.31}$). The value used for estimation of the millicuries of P^{32}

4. Sognnaes, R. F. Preparation of thin "serial" ground sections of whole teeth and jaws and other highly calcified and brittle structures. Anat. Rec. 99:133 (Oct.) 1947.

5. Sognnaes, R. F., and others. A method for radioautography of specimens composed of both hard and soft structures. Anat. Rec. 104:319 (July) 1949.

administration was 2.22×10^9 disintegrations per minute. The presence of radioactivity in the teeth will be described as P^{32} distribution or "uptake." The degree of radioactivity will be expressed as counts per minute per milligram of air-dried tooth substance. The values recorded in the text and in the tables have had the background radioactivity deducted and are corrected to the zero hour at the beginning of the experiment to compensate for "decay" of the radioisotope.

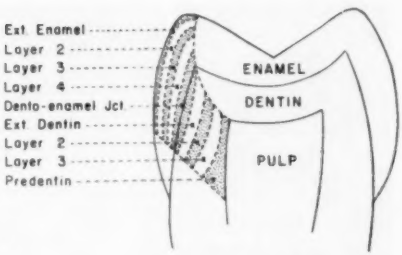


Fig. 3 • Approximate location of the various layers of (buccal) enamel and dentin removed by grinding

EXPERIMENTAL RESULTS

Observations in Intact Animals • Two sets of experiments were carried out in this series; relatively long-term studies, lasting 1 to 9 days, and short term tests in anesthetized animals, lasting from 5 to 24 hours. In the first category, 11 rhesus monkeys were injected intravenously with large dosages of P^{32}, ranging from 6 to 18 millicuries of P^{32}. At the termination of the experimental period the monkeys were sacrificed, roentgenograms were taken of the jaws (Fig. 4, C and D) and representative teeth were prepared for radioactivity evaluations, either by radioautography of plastic-embedded sections (Fig. 4, E, F, G, H, I, J), or on a unit weight basis, using samples obtained by grinding and bromoform separation (Tables 1, 2 and 3).

In monkeys which have been injected with eight or more millicuries of P^{32} and maintained for 72 hours or more, mild hematologic changes were observed. The monkey which received the largest P^{32} dosage will serve as the best example. This monkey weighed 3,420 Gm. and was injected with 18 millicuries of P^{32}. Before P^{32} administration the red blood cell count was 5,300,000 per cubic millimeter and the hemoglobin level 12.8 Gm. per 100 ml. After 72 hours, the red blood count was found to be 4,300,000 per cubic millimeter and the hemoglobin level 9.8 Gm. per 100 ml. No quantitative effect was detected on the white blood cells. At the time of sacrifice, the P^{32} level of the blood was 63,900 counts per minute per milliliter. These changes were the most severe of those observed in the monkeys investigated in this group of experiments.

Observation on the levels of P^{32} in the blood, saliva and bones were included in representative animals of this series, and will be illustrated in terms of an individual monkey weighing 3,190 Gm. A blood sample taken 15 minutes after the intravenous administration of 1.24×10^{10} counts per minute of P^{32} contained 250,000 counts per minute per milliliter. When sacrificed 216 hours later, a sample of peripheral blood contained 65,000 counts per minute per milliliter and a sample of saliva contained 49,000 counts per minute per milliliter. Determination of the radioactivity of the inorganic and organic substance in various regions of the bones was made after glycol ashing. Inorganic salts from the shaft, the diaphysis and the epiphysis contained 800, 2,500 and 5,250 counts per minute per milligram of inorganic matter, respectively. Organic matter from the same regions contained 219, 151 and 247 counts per minute per milligram. These values, as stated, were corrected for the decay rate of P^{32} with the zero hour designated as the moment of P^{32}

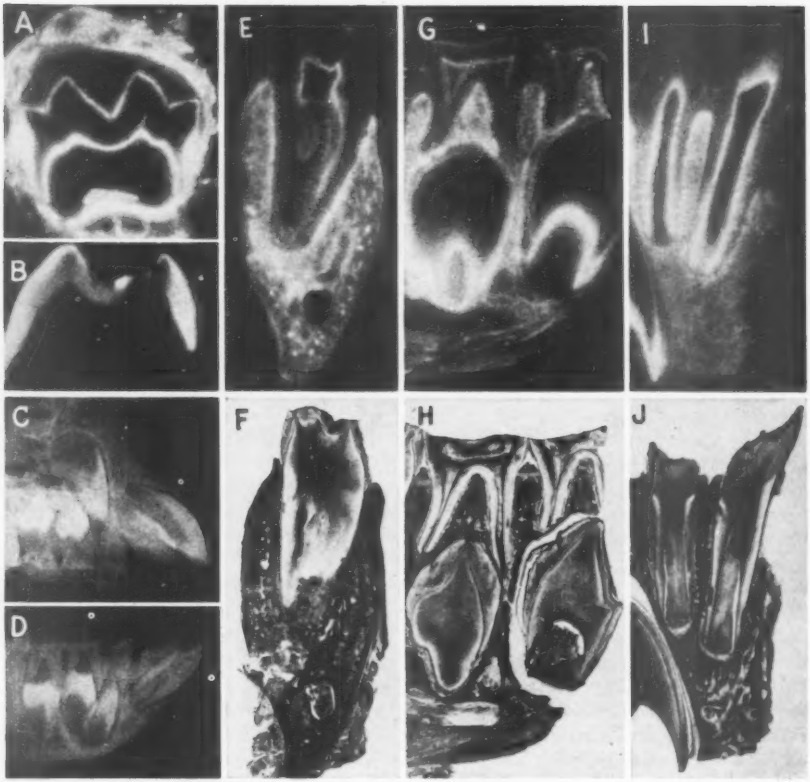


Fig. 4 • A: Radioautograph of section of second permanent molar of a 2 year old monkey weighing 2,600 Gm.; intravenous P^{32} dosage, 5×10^9 counts per minute; sacrificed after 10 hours. Radioautograph obtained by brief exposure of jaw section containing unerupted second molar and surrounding tissues with a great range in hardness and P^{32} activity. B: Radioautograph of similar type of section obtained by prolonged exposure following removal, by means of dental drills, of all tissue components except the dental enamel. C, D, E, F, G, H, I, J: The jaws and teeth of monkey weighing 3,400 Gm., approximately 3 years old. Intravenous P^{32} dosage of 1.0×10^{10} counts per minute. Animal sacrificed after 94 hours. Jaw segments embedded in plastic, sectioned directly with rotating steel saws and, without further grinding, placed on du Pont high-speed Panchromatic film for 20 hours and then developed in Microdol for 15 minutes. C and D: Roentgenograms of right segments of the maxilla and mandible prior to sectioning. E and F: Sagittal sections of mandible in the region of the first permanent molar. Radioactivity of whole section (E) approximately 4,600 counts per minute. (For average P^{32} gradients in various layers of enamel and dentin in this type of teeth see Table 1.) G and H: Longitudinal sections through mandible in the region of the developing first and second permanent premolars. Radioactivity of whole section (G) approximately 13,000 counts per minute. Separated samples from corresponding unerupted teeth from the same animal gave 1,000 counts per minute for whole enamel and 3,000 counts for whole dentin. (For average P^{32} distribution at this stage see Table 2.) Notice also predentin and surface activity in the worn deciduous teeth. I and J: Oblique sections of mandible in the region of the recently erupted incisors. Radioactivity of whole section (I) 9,000 counts per minute. Notice that the intense radioactivity of the dentin is mainly contributed by the internal zone

Table 1 • P^{32} distribution in fully erupted first permanent molars of 11 rhesus monkeys after intravenous administration of 6 to 18 millicuries of P^{32}

Tissue areas	Method of preparation	No. of samples	Radioactivity*	
			Range	Average
Enamel—external layer	Grinding	9	87— 258	169
Enamel—second layer	Grinding	4	34— 191	63
Enamel—third layer	Grinding	6	15— 61	26
Enamel—fourth layer	Grinding	3	7— 20	14
Dentoenamel junction	Grinding	6	16— 68	42
Dentin—external layer	Grinding	7	29— 119	56
Dentin—second layer	Grinding	9	145— 285	208
Dentin—third layer	Grinding	10	238— 540	407
Predentin	Grinding	6	1,080—2,540	1,390
Whole enamel	Bromoform separation	12	34— 236	83
Whole dentin	Bromoform separation	14	158— 754	398

*Values expressed in number of counts per minute per milligram of air-dried samples.

injection. The dental tissues were subjected to more detailed analysis.

Table 1 lists the P^{32} values of tooth samples prepared by grinding and by bromoform separation of the enamel and dentin of fully erupted first permanent molars. A noticeably decreasing P^{32} gradient is evident from the external surface layer to the internal enamel; a similarly significant but reversed gradient is observed in the dentin with increasing P^{32} values from the external layer (dentoenamel junction) to the predentin. These types of gradients were also observed in other erupted teeth, of both the permanent and deciduous dentitions. Pictorial evidence of the gradients within the teeth was obtained from the radjoautographs, a few examples of which are shown and described in the accompanying illustrations. On a unit weight basis the P^{32} distribution in whole dentin and whole enamel of the erupted first molars was on the average in the ratio of 5:1.

Table 2 presents a comparison of the P^{32} distribution in fully erupted teeth versus immature teeth of the same type which were still in the process of eruption. The fully erupted teeth were those observed to be in complete, functional occlusion, while the erupting teeth consisted of well developed crowns in the process of eruption within the jaw or emerging into the oral cavity. Roentgenologically the enamel of all these teeth appeared to be fully calcified. Radiochemically, on the other hand, the results in Table 2 indicate a considerably higher P^{32} activity in the enamel of the erupting teeth than in the erupted teeth as is also evident from Figure 4, A and B. The ratio of radioactivity between whole enamel and dentin of fully erupted teeth was 1:8 as compared to approximately 14:17 for immature teeth (Table 2).

In the next experiment of this series, 4 monkeys were used, the purpose being to indicate: first, the feasibility of obtaining significant and reproducible P^{32} counts in the enamel within a five-hour experimental period—a time limit convenient for future short term experiments; second, the degree of variability in P^{32} distribution between bilaterally symmetrical teeth and in different types of teeth, such as incisors, first and second molars

Table 2 • P^{32} distribution in premolars and second permanent molars at two developmental stages in intravenously injected rhesus monkeys

Tissue areas	Method of preparation	Developmental stage of teeth	No. of samples	Radioactivity*	
				Range	Average
External enamel	Grinding	In function	8	140— 442	240
		Erupting	5	659—1,860	1,190
Internal enamel	Grinding	In function	4	37— 147	89
		Erupting	4	236—1,110	346
Whole enamel	Bromoform separation	In function	8	52— 144	102
		Erupting	17	145—2,760	1,390
Whole dentin	Bromoform separation	In function	7	372—1,540	798
		Erupting	15	598—3,030	1,650

*Values expressed in number of counts per minute per milligram of tissue.

—all large teeth, suitable for contemplated experiments; and third, the ratio of P^{32} uptake in enamel to that in dentin in intact teeth—a ratio essential as a base line before proceeding to alter experimentally the external (salivary) and internal (pulpal) P^{32} supply to the enamel and dentin.

Each animal was anesthetized with pentobarbital (approximately 30 mg. per kilogram of body weight), and injected intravenously with 8 millicuries of P^{32}. After five hours the animals were sacrificed, at which time the levels of P^{32} in whole blood varied from 157,000 to 235,000 counts per minute per milliliter with an average of 198,000 counts per minute per milliliter. Individual teeth were powdered, and enamel and dentin separated by the centrifugation-flotation method described earlier.

The results, shown in Table 3, indicate that significant counts (two or more times the background) were obtained in the enamel of all teeth, with dentin counts as much as 14 times higher than enamel. In recently erupted teeth, the enamel again was observed to be more radioactive than in the older teeth; in one animal (no. 13) the barely erupted second molars showed a P^{32} uptake in the enamel comparable to that in the dentin of the same teeth. Bilateral comparisons of symmetrical teeth are listed and indicate that the procedures gave satisfactorily reproducible results.

Observations in the Absence of Saliva • In the first approach to the specific problem outlined in the beginning of the article, an attempt was made to reduce the salivary secretion at its origin by surgical removal of the parotid and submaxillary glands. This procedure was chosen in order to avoid the use of artificial caps over the teeth which would have necessitated a short term experiment. Hence, the animals, two desalivated and two control, could be kept without anesthesia and for a longer period, 72 hours, after the intravenous P^{32} administration of 9 millicuries of P^{32}. On sacrifice of the monkeys, samples of enamel were prepared in two ways: first, by diamond grinding which gave an indication of the surface activity of the enamel; and second, by powdering and separation into two density fractions from 2.61 to 2.85 and over 2.86, respectively. Samples of dentin were prepared from the powdered crowns of the same teeth, excluding the cementum and

representing tooth substance below a density of 2.61. Other samples were prepared by the segmentation method which revealed differences which were not apparent from the powdered samples.

The results in Table 4 show that in samples prepared by gravimetric separation no remarkable differences could be observed between the radioactivity of the enamel and dentin in intact and desalivated animals. The surface enamel samples were comparable in experimental and control groups; in both, the external enamel was considerably more radioactive than the bulk of the enamel whether of high or low density. In this respect, the results for both groups were in harmony with previous work in intact cats and dogs in which the teeth were surrounded by a free flow of saliva.[1] Hence, the present findings may be interpreted to mean that contact with the oral mucosa and the secretions of the sublingual and mucous glands, in the absence of the major salivary glands, gave results more in line with those seen with normal environmental conditions than with capped dry teeth used in earlier work.[1] In fact, clinically, the oral cavity appeared to be surprisingly moist in the operated animals. Furthermore, the mixture of secretions from the remaining mucous glands were observed to be as radioactive as the mixed salivary secretion of the unoperated control animals.

Nevertheless, it was unexpected that the viscous nature of the mucous gland secretions should not give rise to some differences in the P^{32} uptake, at least in certain portions of the enamel. If such changes occurred only in small areas of the enamel, the extent of these differences might be insufficient to be reflected in the large samples of powdered whole teeth where only the average radioactivity of all the component parts can be determined. Therefore, additional samples of enamel from small select areas were prepared by the segmentation procedure from tooth slabs of intact and desalivated animals. These samples were weighed, dissolved in acid and counted. Particular care was taken to include the cervical area of the enamel which is of sufficiently low specific gravity that it might not be included in the enamel fraction prepared by the usual gravimetric procedure. In 8 samples tested, all

Table 3 • P^{32} distribution in whole enamel and whole dentin of intact, erupted teeth of normal rhesus monkeys five hours after intravenous P^{32} administration

Type of tooth	Monkey no.	Radioactivity*						Dentin/enamel ratio
		Enamel			Dentin			
		Right	Left	Average	Right	Left	Average	
First permanent molars	14	18	28	23	300	362	331	14
	13	33	53	43	524	573	548	12
	12	52	84	68	—	—	—	—
	11	45	60	52	628	680	654	12
Central permanent incisors	14	22	23	22	219	254	236	11
	13	49	65	57	603	691	647	11
	12	116	117	116	783	806	794	6
	11	334	349	341	920	949	934	3
Second permanent molars	12	106	147	126	989	1,193	1,041	8
	13	1,575	1,623	1,599	1,365	1,549	1,457	1–

*Values expressed in number of counts per minute per milligram of tissue.

from first permanent molars, the results were 37, 41, 41 and 82 counts per minute per milligram of enamel from the desalivated monkeys as compared to 104, 111, 153 and 201 counts per minute per milligram in enamel from the control animals. Statistical treatment of these data shows that the critical ratio of the difference between the means to the standard error of the difference between the means was 4.3, which strongly suggests that there was a significant reduction of P^{32} uptake in certain portions of the enamel in the desalivated animals. It is possible that this difference may be caused by the inclusion in the segmentation samples of the cervical, low density fraction of enamel. Since this area is partly below the gingival margin, mixed saliva of normal quantity, quality and consistency may have been of more critical importance for the P^{32} uptake in the cervical enamel.

In view of this observation, it was deemed advisable to examine further the distribution of P^{32} in different layers of enamel after intravenous P^{32} administration: (1) without exposure of the enamel surface to saliva; (2) with exposure of the enamel surface to nonradioactive saliva collected from the same monkey just prior to the intravenous P^{32} injection; and (3) with exposure of the control teeth to the radioactive saliva produced by the monkey during the experiment. Two monkeys and 1 dog were used in this study which, of necessity, had to be conducted for a five-hour period under deep anesthesia. The experimental teeth were isolated from the oral cavity by plastic tubes in the manner described earlier. On one side, the isolated teeth were covered with the animal's own nonradioactive saliva collected previous to the beginning of the experiment. The symmetrical, isolated teeth on the opposite side were left dry. At this point, a suitable amount of P^{32} was injected. The control teeth were not isolated in any way but were bathed by the animal's radioactive saliva throughout the experiment.

The results from the first monkey which had received 10 millicuries of P^{32} are shown in Table 5. In the lower portion of the table, the radioactivity measurements of pooled dentin samples are included to indicate that comparable amounts of P^{32} have reached the dentin through the internal blood supply

Table 4 • P^{32} distribution in enamel and dentin of erupted teeth of intact (controls) and surgically "desalivated" rhesus monkeys 72 hours after intravenous administration of 8 millicuries of P^{32}

Type of samples prepared	Type of animals			
	Controls		Desalivated	
	No. of teeth	Average radioactivity*	No. of teeth	Average radioactivity*
Incisors				
Enamel, surface layer	6	147	8	132
Enamel, density 2.61–2.85	5	56	6	73
Enamel, density 2.86–3.00	1	51	1	56
Dentin, crown portion	6	624	6	978
First molars				
Enamel, surface layer	2	213	2	308
Enamel, density 2.61–2.86	2	137	2	73
Enamel, density 2.86–3.00	2	35	2	40
Dentin, crown portion	2	337	2	424

*Values expressed in number of counts per minute per milligram of tissue.

Table 5 • Distribution of intravenously administered P^{32} in enamel and dentin of first permanent molars surrounded by a radioactive or a nonradioactive external environment*

Tissue areas	Radioactive oral environment		Nonradioactive oral environment	
	Saliva (Right)	Saliva (Left)	Saliva (Right)	Dry (Left)
Enamel—external layer	50	65	1	2
Enamel—second layer	21	13	9	5
Enamel—third layer	20	19	7	14
Enamel—fourth layer	26	26	2	3
	(Both sides)		(Both sides)	
Dentin—external layer	48		46	
Dentin—second layer	105		94	
Dentin—third layer	467		385	
Dentin—fourth layer	490		498	

*Radioactivity values expressed in number of counts per minute per milligram of tissue.

whether the teeth were surrounded by radioactive saliva or not. On the other hand, there has been no significant uptake of P^{32} by the enamel of those teeth whose surfaces have been dry or in contact with nonradioactive saliva. The highly significant decrease in the outer enamel layer which normally exhibits the highest radioactivity is particularly striking. Therefore, it is evident that the presence around the tooth of nonradioactive saliva *per se* has failed to maintain the P^{32} gradient from internal to external enamel. During the five-hour experimental period, none of the intravenously injected P^{32} penetrated through the enamel into the saliva. The same experimental procedure was tested in a dog to which 18 millicuries of P^{32} was administered with the same results. A second monkey experiment was performed for five hours following intravenous injection of 10 millicuries of P^{32}. Again, the outer enamel layer gave negative counts (0.6 counts per minute per milligram) as compared to a highly significant radioactivity (177 counts per minute per milligram) in the control teeth which were surrounded by the P^{32} containing saliva secreted by the animal.

These findings are interpreted to indicate that the elevated activity normally observed in the surface layer of the enamel of P^{32} injected animals must be due largely to direct contact with salivary P^{32} as such, rather than to the contact with saliva *per se*.

Observations in the Presence of Modified Saliva • These findings do not eliminate the possibility that the P^{32} uptake of the enamel may to some extent be controlled by phenomena within the tooth itself. If affected by such mechanisms as osmotic pressure gradients between pulp fluid and saliva, then the P^{32} distribution in enamel possibly can be influenced by altering the salivary fluid experimentally. Three experimental conditions were set up in an attempt to examine this problem.

In the first test the anesthetized animals were prepared as follows: bilaterally symmetrical teeth were segregated from the oral fluids by means of rubber dam and plastic tubes secured to the cervical margin of the teeth, as described earlier. One of these tubes was filled with 1 ml. of nonradioactive saliva (previously collected from the same monkey by means of pilocarpine stimulation), the other with 1 ml. of a mixture of equal parts of this same saliva sample and water. Control teeth were allowed to remain in direct contact with the biologically radio-

active saliva secreted by the monkey during a five-hour experimental period following intravenous administration of 10 millicuries of P^{32}. The results presented in Table 6 indicate that comparable radioactivity was found in the bilaterally symmetrical control teeth which were in contact with the radioactive saliva. Both teeth showed a consistent P^{32} gradient toward the external enamel surface. On the other hand, teeth surrounded by the nonradioactive saliva fluids had essentially negative counts in the external enamel layers, whereas dentin counts were comparable in all groups of teeth. In addition, no significant amount of P^{32} was observed to have penetrated from the dentin through the enamel into the surrounding salivary fluids in the course of the five-hour experimental period. These observations were confirmed in similar experiments in another monkey and in 1 dog.

In the second type of experiment in this series, it was decided: first, to prolong the experimental period to 24 hours; second, to increase the intravenous P^{32} dosage to 20 millicuries; and third, to elevate the osmotic pressure around the external tooth surface by adding 0.2 Gm. of sucrose to 0.8 ml. of saliva to make a 20 per cent solution. Under these circumstances measurable but comparable amounts of P^{32} (80 counts per minute per milliliter) could be demonstrated in the saliva and in the saliva-sucrose mixture within the two plastic tubes placed over the molar crowns of the animal. These results indicate first, that traces of P^{32} may pass through the dentin and the enamel in the course of a 24-hour period, and second, that this alteration in osmotic pressure did not modify the centrifugal passage of P^{32} from the pulp to the saliva. As far as the teeth themselves are concerned, Table 7 shows that the enamel of the control teeth which were surrounded by the animal's own radioactive saliva had high P^{32} counts. However, the enamel of the teeth surrounded by nonradioactive saliva had practically negative counts whether sucrose was added or not.

The third type of experiment of this series, the results of which are shown in Table 8, consisted in an external exposure of vital teeth to artificially radioactivated saliva (15×10^6 counts per minute per milliliter) with or without the addition of sucrose but without internal P^{32} administration. A sucrose concentration of 20 per cent was chosen because an exploratory experiment with a 10 per cent solution had given insignificant re-

Table 6 • P^{32} distribution in first permanent molars surrounded by radioactive or nonradioactive salivary solutions following intravenous P^{32} administration*

Tissue areas	Teeth surrounded by radioactive saliva			Teeth surrounded by nonradioactive solution			Radioactive/ nonradioactive ratio
	Right	Left	Average	Saliva	½ saliva ½ water	Average	
Enamel—external layer	90	98	94	7	3	5	23
Enamel—second layer	35	54	44	1	7	4	11
Enamel—third layer	18	44	36	7	3	5	7
Enamel—inner layer	22	16	19	28	17	23	1—
Dentin—external layer	27	41	34	38	40	39	1—
Dentin—second layer	42	51	47	60	50	55	1—
Dentin—third layer	145	328	237	282	171	227	1+
Predentin	1,650	1,500	1,580	2,400	1,970	2,190	1—

*Radioactivity values expressed in number of counts per minute per milligram of tissue.

sults. A considerable penetration of P^{32} into the tooth enamel from the external surface was observed. Four to 10 times as much radioactivity was observed in the enamel layers of the tooth with no sucrose addition. Four additional samples were taken from each tooth below the occlusal surface successively through the dentoenamel junction and into the dentin. In that order the layers of dentin contained 29, 32, 8, and 0 counts per minute per milligram, respectively, for the tooth surrounded by the saliva, and 8, 0, 0, 0 counts per minute per milligram, respectively, for the tooth surrounded by the saliva plus 20 per cent sucrose solution. In other words, under the conditions of these trials, sucrose appeared to have an inhibitory effect on the centripetal passage of P^{32} into both enamel and dentin.

Observations in Pulpless and Extracted Teeth • In this series of studies, the internal blood supply to the teeth was altered either by the removal of the pulp or by severing the complete tooth from the jaw, using bilaterally symmetrical vital teeth *in situ* for controls.

The results of two such studies are shown in Tables 9 and 10. The effect of pulp removal and root filling was evaluated following intravenous P^{32} administration. After five hours, enamel and dentin samples were prepared by powdering the crowns of the teeth and separated by the standard centrifugation-flotation procedure. The bilateral control tests of intact teeth (Table 9) indicated comparable radioactivity in the enamel and dentin of teeth on the right and left sides of the jaw. A similar bilateral comparison between intact and root-filled teeth is shown in the right-hand columns of Table 9. Here the radioactivity of whole dentin of the pulpless teeth is, on an average, only one-ninth of that in the intact ones. In the enamel samples, there is a minor reduction in the radioactivity of the pulpless teeth, but this difference is insignificant compared to that previously observed in the absence of saliva, in which case (Table 5) the counts were practically negative. It is interesting to note, on the other hand, that whole dentin, even in the absence of the pulp, contains measurable amounts of P^{32}. The fact that some of these values exceed those in enamel tends to rule out salivary P^{32} penetration as the source of this activity. It is more likely that some of the radioactivity in the dentin of the

Table 7 • P^{32} distribution in teeth with different external environment during 24 hours after intravenous administration of 18 millicuries of P^{32}*

Samples	Radioactive saliva		Nonradioactive saliva					
			Plain			With 20% sucrose		
	Right bucc.	Left bucc.	Left bucc.	Left occl.	Left ling.	Right bucc.	Right occl.	Right ling.
Enamel—external layer	218	164	1	4	17	4	5	11
Enamel—second layer	91	91	0	1	1	0	1	2
Enamel—third layer	20	15	0	4	1	1	2	0
Enamel—fourth layer	4	20	4	10	2	5	29	2
Dentoenamel junction	25	27	29	63	12	55	46	17
Dentin—external layer	67	119	162	150	101	163	130	97
Dentin—second layer	176	285	211	245	145	326	240	204
Dentin—third layer	486	540	527	381	367	684	438	421

*Radioactivity values expressed in number of counts per minute per milligram of tissue.

Table 8 • Effect of 20 per cent sucrose addition to radioactive saliva on the P^{32} distribution in the enamel of vital teeth*

Samples	Exposure to radioactive saliva				Exposure to radioactive saliva with 20% sucrose added				Ratio
	Bucc.	Occl.	Ling.	Avg.	Bucc.	Occl.	Ling.	Avg.	
Enamel—external layer	2,860	1,890	439	1,730	580	126	60	255	7
Enamel—second layer	122	547	115	291	14	51	19	28	10
Enamel—third layer	48	109	27	61	8	24	23	18	5
Enamel—inner layer	9	91	9	36	5	6	12	7	5

*Radioactivity values expressed in number of counts per minute per milligram of tissue.

pulpless teeth may have originated from the blood supply of the periodontal tissues surrounding the teeth. Procedures are being developed whereby this possibility can be put to more critical experimental test.

For the present it seemed important to establish more accurately the distribution of blood-borne P^{32} in different layers of enamel and dentin in intact and pulpless teeth, respectively. Five hours after intravenous P^{32} administration, the teeth were extracted and layers of enamel and dentin were removed successively from the external enamel layer to the internal dentin surface. From these tests (Table 10) it became clear that the radioactivity of dentin in intact teeth is to a major extent contributed by the internal layer near the pulp (predentin). This was also evident from radioautographs of intact teeth (see Fig. 4, A, E, G and I). The radioactivity of the predentin was completely abolished when the pulp was removed. On the other hand, the results in the enamel (Tables 9 and 10) indicate that considerable radioactivity was present in spite of the pulpectomy. The fact that the radioactivity of enamel surface was comparable in the intact and the root-filled tooth was an additional indication that the salivary P^{32} was the

Table 9 • Bilateral comparisons between the P^{32} uptake by whole enamel and dentin of rhesus monkeys after intravenously injected P^{32} in the presence and absence of normal blood supply to the pulp*

Dental tissues	Bilateral control tests			Pulp supply varied		
	Right-side	Left-side	Ratio R/L	Present (right)	Absent (left)	Ratio R/L
Enamel	22	23	1.0	26	12	2.2
	45	60	0.8	33	7	4.7
	49	65	0.8	58	62	0.9
	53	33	1.6	82	79	1.0
	111	151	0.7	99	80	1.2
	116	117	1.0	116	67	1.7
Average	66	75	0.9	69	51	1.4
Dentin	219	254	0.9	235	21	11.3
	300	363	0.9	344	33	10.4
	629	680	0.9	1,020	167	6.1
	949	920	1.0	1,240	109	11.4
Average	524	554	0.9	710	83	8.6

*Radioactivity values expressed in number of counts per minute per milligram of tissue.

main source of the enamel radioactivity.

However, it is probably incorrect to assume that the pulpless teeth were entirely nonvital, by reason of the vascular communication from the periodontal supporting structures, possibly by way of the Tomes' granular layer of the root surface and the dentoenamel junction.

An exploratory experiment was set up to test the effect of altering the internal blood supply of the teeth under somewhat extreme conditions. Artificially radioactivated saliva (50,000 counts per minute per milliliter) was placed externally around the teeth within plastic tubes sealed at the neck of bilaterally symmetrical first permanent molars. One of the teeth was removed from the jaw and tested *in vitro,* completely severed from internal blood supply of pulpal as well as periodontal origin. The control tooth was kept in the living animal but was otherwise surrounded externally by the same salivary P^{32} mixture. No P^{32} was injected into the monkey. It was observed (Table 11) that the enamel of the vital tooth took up from three to nine times greater amounts of P^{32} than the extracted tooth even though the teeth were in contact with identical samples of radioactive saliva for the same lengths of time. Small but measurable amounts of P^{32} also penetrated into the depth of the underlying dentin of the vital tooth.

Table 10 • Effect of pulp extirpation on the P^{32} uptake of successive layers of enamel and dentin following intravenous P^{32} administration*

Types of sample	Intact tooth	Root-filled tooth
Enamel—external layer	46	49
Enamel—second layer	51	10
Enamel—third layer	23	4
Dentoenamel junction	57	24
Dentin—external layer	9	3
Dentin—second layer	8	0
Dentin—third layer	16	0
Predentin	638	0

*Radioactivity values expressed in number of counts per minute per milligram of tissue.

COMMENT

These findings demonstrate that the P^{32} secreted in the saliva is the main source of the radioactivity observed in the dental enamel following internal P^{32} administration. Likewise, they indicate that the P^{32} carried in the blood supply to the pulp is the chief source of the radioactivity in the dentin following intravenous injection of P^{32}.

At the moment, it is not possible to explain by any one mechanism the gradients in P^{32} distribution which have been observed in the various layers of enamel and dentin of the teeth.

The elevated P^{32} activity in the inner dentin zone may be logically accounted for because of the active matrix formation and deposition of phosphorus-containing compounds known to take place in this region. Yet, intense radioactivity in this layer in old teeth has also been observed, even in those that had nearly completed their functional period, as was evident from radioautographs of the deciduous teeth (see Fig. 4, G).

The enamel of fully formed teeth presents a somewhat different situation than dentin and bone in the sense that the apposition of any new tissue can be ruled out. In addition, the phosphorus content of mature enamel is remarkably constant, and chemically it has proved to be extremely difficult, if not impossible, to detect any acquisition of new phosphorus during brief experimental periods. Nevertheless, intravenously injected P^{32} could be detected rapidly in the enamel of erupted teeth. Furthermore, the surface layer of the enamel, which histologically shows less organic pathways than internal enamel[6] actually revealed significantly

6. Sognnaes, R. F. The organic elements of the enamel. II. The organic framework of the internal part of the enamel with special regard to the organic basis for the so-called Tufts and Schreger's bands. J.D. Res. 28:549 (Dec.) 1949.

Table 11 • P^{32} uptake by the enamel of vital and extracted teeth surrounded by artificially radioactivated saliva*

Tissue layers	In vivo	In vitro	In vivo/in vitro ratio
Enamel—external layer	1,470	389	4
Enamel—second layer	1,080	131	8
Enamel—third layer	354	83	4
Enamel—fourth layer	375	78	5
Dentoenamel junction	411	45	9

*Radioactivity values expressed in number of counts per minute per milligram of tissue.

more P^{32} than the internal enamel, sometimes as much as the calcifying predentin.

If the observed P^{32} gradients were caused by simple diffusion from the surrounding radioactive environment (blood and saliva), a much more intensive radioactivity would have been suspected in the external dentin which has an open tubular communication system with the pulpal blood supply. Yet, P^{32} present in the densely calcified external enamel layers was noted to consistently exceed that in the external dentin. Although the P^{32} content of saliva did not exceed that of the blood, it may be significant that saliva, in contrast to blood, contains predominantly inorganic phosphorus.

Our evidence appears to indicate quite conclusively that the salivary secretion is the predominant source of the P^{32} recovered in the enamel. This would be in keeping with the operation of a surface adsorption phenomenon, were it not for the depth of the penetration of P^{32} and its persistence after thorough washing. *In vitro* tests[7, 8] have indicated that P^{32}, as well as Ca^{45}, are taken up readily by hydroxyapatite, powdered bone, dentin and, to a lesser extent, enamel. In all instances, these *in vitro* data suggested that the uptake was due to a mechanism of exchange. This is not a completely satisfactory explanation for the *in vivo* findings, because we have noted, among other things, that the enamel of vital teeth took up considerably more P^{32} than comparable nonvital (extracted) teeth when both were exposed to an identical external P^{32} environment. However, the same may well be true of bone, with the difference between *in vivo* and *in vitro* tests being in degree rather than in nature.

On the basis of present knowledge, a process of exchange, the replacement of P^{31} by P^{32}, appears to be the most satisfactory mechanism suggested for the rapid and wide P^{32} distribution observed in those calcified tissues which are in close proximity to, and in equilibrium with, the blood. Tentatively, the same mechanism could be applied to dental observations if it is assumed that the enamel of erupted teeth is similarly in equilibrium with a salivary secretion whose composition, rate of flow and proximity to the enamel surface is not interfered with. This reasoning by analogy may be objected to on several grounds. First, the properties of the salivary secretion are more liable to abnormal changes than blood. (One could interject—considering the high incidence of dental decay—that the same holds for teeth versus bone.) Second, it is noteworthy that the cells and vascular supply of the bone maintain a close and

7. Falkenheim, M.; Neuman, W. F., and Hodge, H. C. Phosphate exchange as the mechanism for adsorption of the radioactive isotope by the calcified tissues. J. Biol. Chem. 169:713 (Aug.) 1947.

8. Falkenheim, M.; Underwood, E. E., and Hodge, H. C. Calcium exchange; the mechanism of adsorption by bone of Ca^{45}. J. Biol. Chem. 188:805 (Feb.) 1951.

direct contact with the individual subsurface bone constituents. In the acellular and avascular enamel, on the other hand, it will be necessary to explore further such processes as osmosis and diffusion, besides that of exchange, before a satisfactory explanation of the observation made in this investigation can be reached.

In connection with the observation that sucrose has an inhibitory effect on the P^{32} uptake of the enamel, it is interesting to note that tetanus toxin mixed in 20 per cent solution of monosaccharides (glucose or fructose) and kept around the external enamel surface of dogs' teeth, can be recovered from the pulp of the same teeth 24 hours or more later.[9] Solutions of 10 per cent monosaccharide failed to bring about the same change in the permeability of the enamel to the toxin. In view of the significance of sugars in the etiology of caries, it is important to explore further to what extent sugar solutions actually tend to inhibit salivary ion exchange with the enamel on the one hand and induce the penetration of bacterial products on the other.

SUMMARY AND CONCLUSIONS

1. In P^{32}-injected rhesus monkeys, two P^{32} gradients can be observed in the teeth, one decreasing from the internal to the external dentin, the other increasing from the internal to the external enamel.

2. In similarly injected monkeys, the elevated surface activity of the enamel can be eliminated by isolating the teeth from saliva or by surrounding the crowns of the teeth with nonradioactive saliva.

3. The high radioactivity observed in the dentin of P^{32}-injected monkeys is mainly concentrated in the internal dentin, and can be nearly completely abolished by removal of the pulpal blood supply.

4. The salivary P^{32} penetration of enamel from the outside is greater in young than in old teeth and lower in extracted than in vital teeth.

5. Addition of 20 per cent sucrose to saliva significantly reduces the salivary radiophosphorus penetration into the enamel from the outside, but does not significantly alter the penetration of blood-borne P^{32} from the inside of the teeth.

6. It may be concluded that saliva-borne P^{32} is the chief source of radioactivity in the enamel, whereas blood-borne radiophosphorus through the pulp is the major source of the P^{32} uptake of the dentin, but contributes little to the P^{32} uptake in enamel of adult teeth.

9. Berggren, H., and Hedström, H. Experimental studies in vivo on the permeability of enamel with particular regard to the effect of sugar solutions. J.D. Res. 30:161 (April) 1951.

Valuable Result • The most valuable result of all education is the ability to make yourself do the thing you have to do, when it ought to be done, whether you like it or not. *Thomas Huxley.*

Mouth breathing: I. Etiology and effects (a review)

Ronald D. Emslie, B.D.S. (London), M.S.;
Maury Massler, D.D.S., M.S.,*
and Jack D. Zwemer,† D.D.S., M.S., Chicago

Mouth breathing may be defined as habitual respiration through the mouth instead of the nose.

An important function of the nose is the preparation of the atmospheric air for use by the lungs. The nose cleans, moistens and warms the inspired air. Failure to do so, by breathing through the mouth instead of the nose, has been considered to be injurious to the tissues lining the respiratory tract and oral cavity because of the impact of cold, dry and dirty air. It has also been stated that mouth breathing has serious effects on the development of the facial skeleton and the occlusion of the teeth because of the displacement of normal labial, buccal and lingual muscular forces.

The effects of mouth breathing on the tissues of the nose and paranasal sinuses have been studied by the rhinologist. The effects of the habit on the oral soft tissues have been observed by the periodontist, while the orthodontist and pedodontist have studied the effects of mouth breathing on the occlusion of the teeth and the development of the facial skeleton. Thus, the problem of mouth breathing has been studied from different points of view. It is inevitable that some differences of opinion occur as a result of different viewpoints.

The various statements and observations reported in the literature on the cause and effect of mouth breathing will be reviewed in an effort to separate fact from conjecture.

NASAL RESPIRATION

The nose serves two main functions—respiration and olfaction. As an organ of respiration, the nasal cavity prepares the inspired air for entrance into the alveoli of the lungs in the following ways:

Cleansing the Air • When the air first enters the nose, the coarse hairs (vibrissae) just inside the anterior nares prevent the entrance of gross particulate matter such as leaves, twigs or insects (Proetz).[1] The nasal passages are narrow, thin and long ducts so that the partially cleansed air is drawn through the nasal passages and over the nasal mucosa in a thin (laminated) stream instead of in a wide stream as would occur along a cylindrical passageway (Scheideler,[2] Tonn-

From the graduate pedodontics division, University of Illinois College of Dentistry, Chicago.

*Professor of graduate pedodontics, University of Illinois College of Dentistry.

†Instructor of histology, embryology and pedodontics, University of Illinois College of Dentistry.

1. Proetz, A. W. Essays on the applied physiology of the nose. St. Louis, Annals Pub. Co., 1941, p. 5, 6, 31, 36, 42, 159, 205.

2. Scheideler, J. Die Lufströmungen in der menschlichen Nase bei der Atmung. Ztschr. f. Hals-, Nasen-, u. Ohren. 44:228, 1938.

dorf).[3] The cone-shaped structures (turbinates) lying within this thin, narrow corridor serve to throw the thin air currents into an occasionally whorling stream. By this mechanism, a thin layer of air is caused to come in intimate contact with the nasal mucosa. As the air passes over the nasal mucous membrane it is cleansed of such microscopic matter as dust, pollen or bacteria which is caught and held on the sticky "flypaper-like" mucus sheet (Hilding).[4,5] The mucus sheet inhibits bacterial growth by the action of a bacteriostatic agent, lysozyme, (Fleming)[6] which it contains and by its acid pH (5.5 to 6.5) (Fabricant).[7,8]

The Mucus Sheet • The final cleansing of the air is, therefore, accomplished through the medium of a thick, mucoid secretion which forms a continuous sheet or blanket over almost the entire nasal mucosa (Hilding).[4,5] This blanket is elaborated by the goblet cells of the epithelium and by the mucous and serous glands of the submucosa (Proetz).[1]

The mucoid blanket soon would become clogged and bacteria-laden if it were not regularly and quickly removed and then renewed. The removal of the debris-laden mucoid sheet is accomplished by the action of cilia (Fig. 1). The nasal epithelium has cilia (eight hair-like projections per cell) on the outer surface and the mucus sheet actually lies on the cilia rather than directly on the epithelial cells. The cilia beat or rather whip 250 times per minute toward the pharynx (Gray,[9] Hilding).[4,5] This wave-like action carries the mucus blanket containing the entrapped foreign matter to the pharynx where it is swallowed or hawked up and expectorated (Proetz).[1]

Warming the Air • In addition to its cleansing action, the mucous membrane of the nose acts as a radiator to warm and moisten the air while it cleanses it (Gréhant,[10] Collet).[11] Warming is accomplished by radiation of heat from large venous cavities lying under the mucosa of the turbinates (Perwitzschky)[12] (Fig. 1).

Moistening the Air • During the process of warming the air the nasal secretions also humidify it (Fig. 1). Approximately one quart of fluid is secreted each day by the nasal mucosa in order to properly humidify the air (Neivert,[13] Proetz,[1] Fabricant).[8] Persons who breathe through their mouths must give up large quantities of moisture from the oral and pharyngeal mucosa into the inspired air. The oropharyngeal mucosa then becomes dry and the patient has an almost constant sensation of thirst which he attempts to alleviate by drinking large quantities of fluids (Goadby).[14]

It is necessary to cleanse, warm and moisten the air before it impinges on the alveoli of the lungs in order to avoid in-

3. Tonndorf, J. Der Weg der Atemluft in der menschlichen Nase. Arch. f. Ohren-, Nasen- u. Kehlkopfh. 146:41, 1939.

4. Hilding, A. Experimental surgery of the nose and sinuses; I. changes in the morphology of the epithelium following variations in ventilation. Arch. Otolaryng. 16:9 (July) 1932.

5. Hilding, A. Four physiologic defenses of upper part of respiratory tract: ciliary action, exchange of mucin, regeneration and adaptability. Ann. Int. Med. 6:227 (Aug.) 1932.

6. Fleming, Alexander. Arris and Gale lecture on lysozyme; bacteriolytic ferment found normally in tissues and secretions. Lancet 1:217 (Feb. 2) 1929.

7. Fabricant, N. D. Significance of pH of nasal secretions in situ to activity of lysozyme; report of case of experimentally induced allergic rhinitis. Arch. Otolaryng. 41:53 (Jan.) 1945.

8. Fabricant, N. D. Relation of pH of nasal secretions in situ to activity of lysozyme; report of case of experimentally induced allergic rhinitis. Arch. Otolaryng. 41:53 (Jan.) 1945.

9. Gray, J. Ciliary movement. New York, Macmillan Co., 1928.

10. Gréhant, N. Recherches physiques sur la respiration de l'homme. Journ. de l'Anatomie et de la Physiologie 1:523 (Sept.) 1864.

11. Collet, F. J. Contribution a la physiologie de la trachee et de l'oesophage chez l'homme. J. de Med. de Lyon 5:469, 1924.

12. Perwitzschky, R. Die Temperatur und Feuchtigkeitsverhältnisse der Atemluft in den Luftwegen: Untersuchungen unter normalen Aussenbedingungen und bei normaler Atemgrösse am ruhenden Menschen. Arch. f. Ohren-, Nasen- u. Kehlkopfh. 117:1 (Nov.) 1927.

13. Neivert, H. The lymphoid tissue problem in the upper respiratory tract. Am. J. Orthodont. & Oral Surg. 25:544 (June) 1939.

14. Goadby, Kenneth. Diseases of the gums and oral mucous membrane, ed. 4. New York, Oxford University Press, 1931, p. 33, 36.

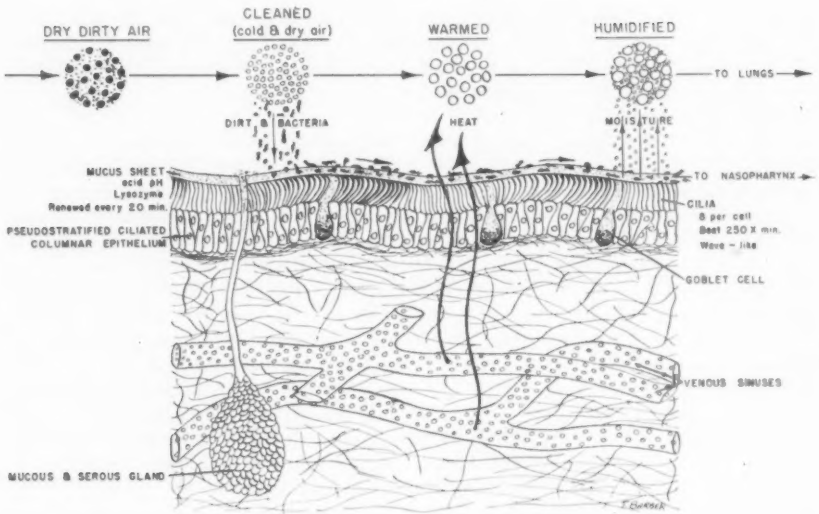


Fig. 1 • Diagram showing the cleansing, warming and humidification of air as it passes over the nasal respiratory mucosa

jury to these delicate structures by cold and dust and bacteria. Warmth and moisture also facilitate the exchange of dissolved gases ($O_2 \leftrightarrow CO_2$) between the air and blood across the alveolar epithelium (Uddströmer).[15]

Tendency to Nasal Respiration • The tendency to nasal respiration is strong. If the nostrils of a sleeping infant are gently occluded, it will continue to sleep peacefully only for about 20 seconds. Then its face will become suffused; it will struggle and then cry out (James and Hastings).[16] Even where there is a congenital absence of a patent nasal passageway (bilateral choanal atresia) the infant tries to breathe through the nose and is unable to breathe through the mouth unless helped (Richardson,[17] Moncrieff).[18]

Attempts by one of us (R.E.) to produce experimental mouth breathing in the albino rat ended in failure. It was found that if the external nares were closed surgically, the animal would gradually inflate its entire alimentary canal in its efforts to exhale and would die within a week. This is one of the reasons why experimental evidence on the effects of complete nasal obstruction in animals is scanty. It would appear that in the rat, the soft palate acts as a partial one-way valve which permits air to enter but not to leave via the mouth.

ETIOLOGY OF MOUTH BREATHING

The causes of mouth breathing are undoubtedly multiple. From a consideration of the literature and discussions with

15. Uddströmer, M. Nasal respiration. Acta oto-laryng. (supp.) 42:3, 1940.

16. James, W. W., and Hastings, S. Discussion on mouth breathing and nasal obstruction. Proc. Roy. Soc. Med. 25:1343 (June) 1932.

17. Richardson, C. W. Congenital atresia of the post-nasal orifice. Lancet 187 (2):439 (Aug.) 1914.

18. Moncrieff, A. Nasal obstruction in the new born. Brit. M. J. 1:1295 (June 27) 1936.

orthodontists, pedodontists, rhinolaryngologists and pediatricians, it seems that two factors, a combination of anatomic predisposition (narrow airway) plus nasal obstruction (enlarged pharyngeal tonsils, engorged nasal mucosa, deviated nasal septum) must be present to cause mouth breathing to be established on an habitual basis (Fig. 2).

Predisposing Factor (The Narrow Airway) • The upper airway consists of two portions, the nasal passages and the nasopharynx. These connect with the lower airway (tracheobronchial tree and terminal alveoli of the lungs) via the larynx. Narrow nasal passages are more easily occluded by nasal obstructions (engorged turbinates) than wide passageways. Clinically, it can be demonstrated also that the narrow nasopharynx of the narrow-faced child is more easily occluded by large pharyngeal tonsils than the wide nasopharynx of the wide-faced child. This may explain the observation that mouth breathing "occurs most frequently in long-faced (dolichofacial), slender persons (ectomorphs) in whom the pharyngeal space is normally long, but very narrow" (Poncher, Schour and Massler).[19] Brash [20] suggested "that 'adenoids'

19. Poncher, H. G.; Schour, I., and Massler, M. The oral cavity. In Nelson, W. E., Mitchell-Nelson textbook of pediatrics, ed. 4. Philadelphia, W. B. Saunders Co., 1945, p. 568-569.

20. Brash, J. C. The aetiology of irregularity and malocclusion of the teeth. London, Dental Board of the United Kingdom, 1929, p. 212-226.

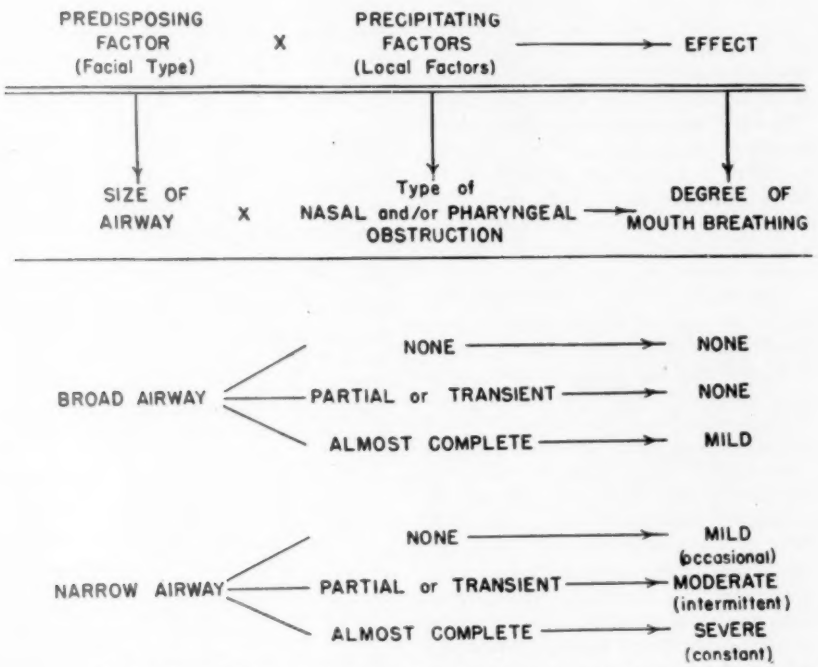


Fig. 2 • Diagram showing the interaction of various factors in the causation of mouth breathing

may be simply evidence of lack of room in the nasopharynx."

Exciting Factor (Nasal or Pharyngeal Obstruction) • Obstruction to nasal breathing may occur from a variety of causes. The most common are (1) engorgement of the turbinates in the nasal passage and (2) enlargement of the lymphoid masses in the pharyngeal airway (Worms and Bolotte,[21] Brash,[20] Neivert).[13]

Engorged Turbinates • Engorged turbinates, especially the middle turbinate, commonly obstruct the nasal passageway, especially if a pronounced deviation of the septum is also present (Neivert,[13] Uddströmer).[15]

Allergy • Engorgement may result from hypersensitivity of the nasal or sinus mucosa to air-borne substances (Fabricant).[8] Fox and Kesel[22] pointed out that nasal allergic conditions of a subclinical or borderline character occur often and may cause nasal obstruction. The nasal obstruction is especially severe during sleeping hours, and it may become complete if the patient is lying on his back (Uddströmer).[15] If the patient lies on his side, the lower half of the nasal tract is occluded but the upper half is usually patent (Fox and Kesel).[22]

Climatic Conditions • The hot dry air of the average overheated home during the winter months, when humidity is low, dries out the mucus sheet and causes nasal congestion and mucosal engorgement (Uddströmer,[15] Ballenger).[23] Dried crusts accumulate in the nasal passages and provide a mechanical obstruction to nasal breathing. This is especially true on awakening when most persons have difficulty in breathing through the nose. Dirty, dust-laden air in industrial areas aggravates this condition, especially in individuals with hypersensitive nasal mucous membranes. In areas where the characteristic facial type is narrow, and the climate unfavorable as well as dust-laden, an increased incidence of mouth breathing might be expected and, in fact, has been noted. "There are more mouth breathers to the acre in England than in any other country" (Osler quoted by Brash).[20]

Chronic Rhinitis and Sinusitis • It is surprising to discover how many persons suffer from chronic inflammation of the nasal and sinus mucosa. As has been pointed out, it may have a background in the hypersensitivity of the mucosa or in the dry and dust-laden condition of the air. Such repeated insults to the nasal mucosa inevitably lead to a breakdown in the nasal defenses with the result that chronic congestion and infections occur. Thus a vicious cycle is initiated and mouth breathing becomes inevitable as a result of the chronic congestion. Neivert[13] stated the situation succinctly as follows: "A child who does not breathe well through his nose usually has either sinusitis, allergy or adenoids. Rarely, there may be other causes."

Adenoids • Enlargement of the pharyngeal tonsils, or adenoids, has for years been blamed as the chief cause of mouth breathing (Brash,[20] Neivert).[13] Hyperplasia of all the lymphoid tissues of the body normally occurs in children between 2 and 6 years of age. This is a period of physiologic lymphoid hyperplasia (Scammon).[24] The pharyngeal and palatine lymphoid masses (tonsils and adenoids) are normally large in children 2 to 6 years of age (Fig. 3). They slowly diminish in size thereafter so that some

21. Worms, G., and Bolotte, M. L'insuffisance respiratoire nasale. Paris, Maloine, 1928.

22. Fox, N., and Kesel, R. G. Hyperplastic sinopharyngostomatitis. Arch. Otolaryng. 42:368 (Nov.-Dec.) 1945.

23. Ballenger, W. L., and Ballenger, H. C. Diseases of the nose, throat and ear, ed. 8. Philadelphia, Lea & Febiger, 1943, p. 124, 307-309.

24. Scammon, R. E. The measurement of the body in childhood. In Harris, J. A., and others, The measurement of man. Minneapolis, University of Minnesota Press, 1930.

time during adolescence they have been reduced to much smaller adult dimensions (Todd,[25] Ballenger).[23] As the size of the nasopharynx increases during growth, the relative size of the lymphoid masses becomes smaller and in the adolescent even large lymphoid masses tend

25. Todd, T. W. Integral growth of face: nasal area. Internat. J. Orthodont. 22:321 (April) 1936.

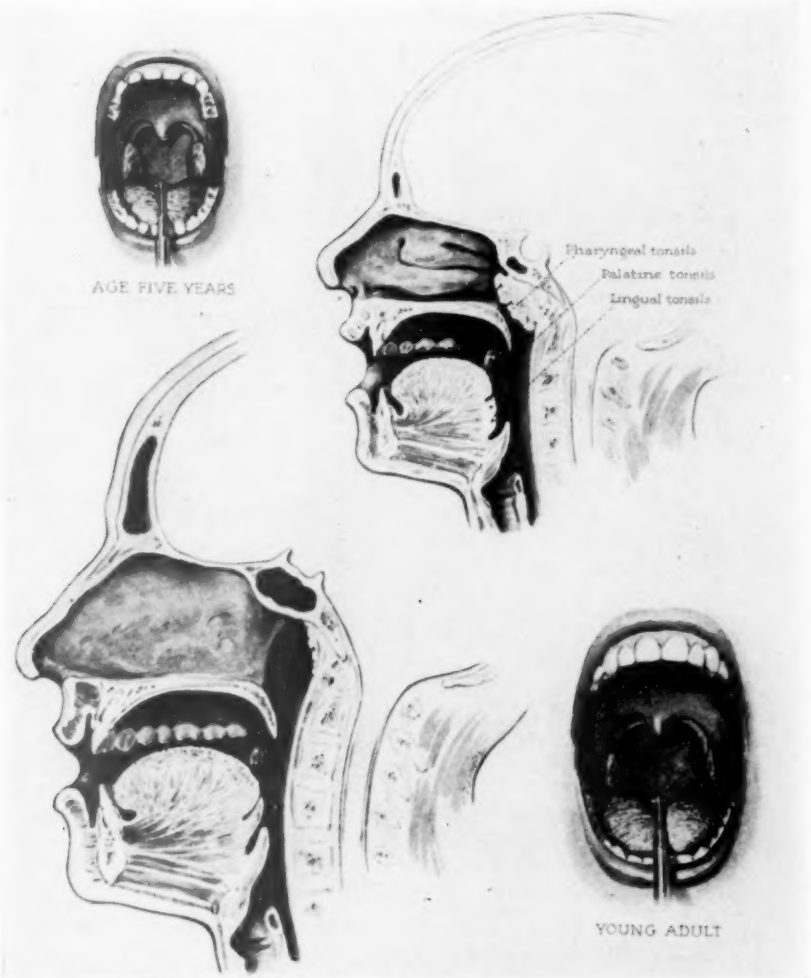


Fig. 3 • The position and size of the pharyngeal and palatine tonsils in the child and young adult (from Atlas of the Mouth *by Massler and Schour)*

to become less obstructive (Todd).[25]

The physiologic hyperplasia of the pharyngeal lymphoid mass probably accounts for the fact that mouth breathing, as a result of obstructive adenoids, is common during the fourth to twelfth year, while the physiologic atrophy of the tonsils plus the increased dimensions of the nasopharyngeal airway accounts for the fact that the obstructive mouth

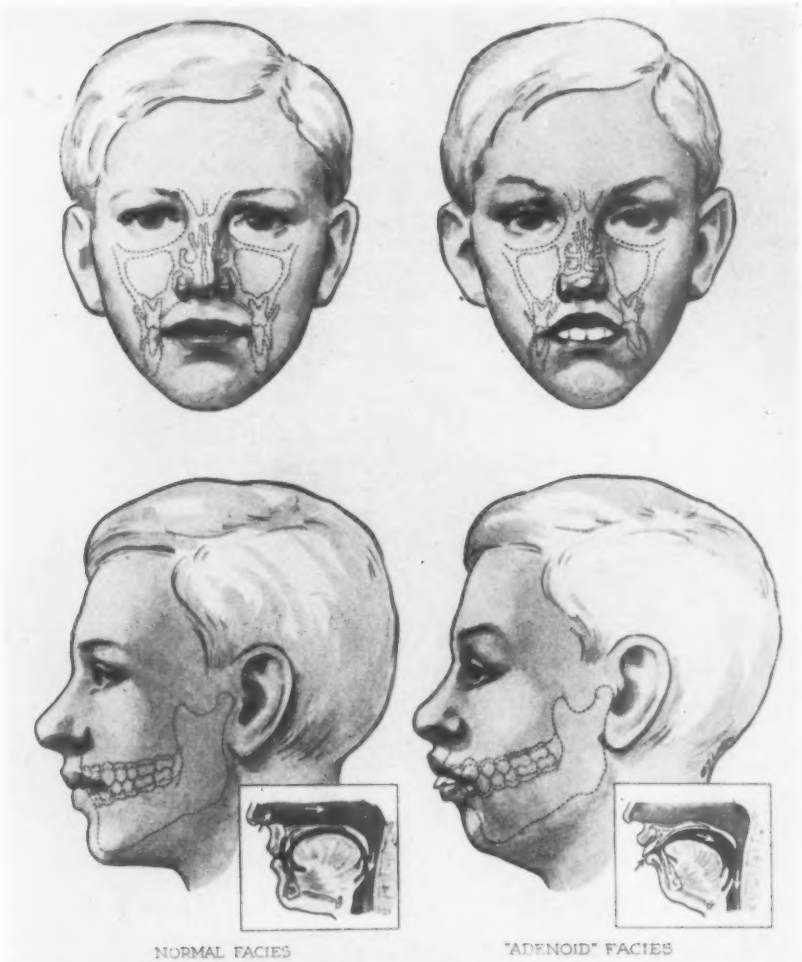


Fig. 4 • The "adenoid facies" compared with a normal face (from Atlas of the Mouth *by Massler and Schour)*

breathing is much less often encountered in the young adult. Many instances of obstructive mouth breathing thus are self-corrected during adolescence.

In the child with a long narrow face and a narrow pharyngeal airway, even physiologic enlargements of the lymphoid masses may become obstructive. In the wide-faced child with a wide pharynx this rarely occurs. The pharyngeal tonsils are the important factors in occluding the pharyngeal portion of the airway since they lie high up in the pharynx and just posterior to the posterior choanae (Fig. 3). The combination of a narrow pharyngeal airway plus hyperplastic pharyngeal tonsils, physiologic or otherwise, inevitably produces obstruction to the pharyngeal airway. A more or less persistent rhinitis is usually associated with obstructive pharyngeal tonsils. This is the "adenoid facies" so often associated with mouth breathing (Fig. 4).

The palatine tonsils are rarely obstructive to nasal breathing. In instances where they are hypertrophied, they press against the postpharyngeal wall when the mouth is opened wide and initiate the gag reflex. Such children are known clinically as "chronic gaggers" (Todd).[25]

In young adults, enlarged adenoids result from chronic inflammation rather than from hyperplasia. Such congested and enlarged pharyngeal tonsils also may cause nasopharyngeal obstructions in the adult with a long, narrow airway.

Some authorities consider the inflammatory condition of the nasopharynx more important than the hypertrophy of the lymphoid tissue in causing nasal obstruction. James and Hastings[16] stated, "Nasal obstruction by adenoids rarely occurs, although the associated catarrh and swelling of the erectile tissue may diminish the airway."

Deviated Nasal Septum • A slightly deviated nasal septum is usually normal and developmental in origin. Such minor deviations are rarely obstructive. On the other hand, septal spurs, severe deviations and subluxations, which are usually the result of injury, may diminish the size of the airway. In such a narrowed nasal passageway, the addition of engorged nasal mucosa makes mouth breathing obligatory (Neivert).[13]

Nasal Polyps • Nasal polyps or, much less frequently, neoplasms also may occlude the airway. Polyps often are the result of chronic inflammatory engorgements of the nasal mucosa. Careful surgical removal quickly alleviates this obstruction (Neivert).[13]

Atrophic Rhinitis • Atrophy of the nasal mucosa occurs occasionally with the result that although the nasal passageway is actually enlarged, nervous or reflex stimulation by the air on the nasal mucosa is lost. Mouth breathing usually occurs in persons suffering from atrophic rhinitis (Neivert,[13] Uddströmer).[15]

Congenital Choanal Atresia • Occasionally the posterior choanae are covered with a membrane which completely occludes the nasal passageway. Such nasal obstructions fortunately are rare (Richardson,[17] James and Hastings,[16] Moncrieff).[18]

PERPETUATING FACTOR (HABIT)

Residual Habit • It is frequently found that mouth breathing persists even after the nasal obstruction is removed. This indicates that these individuals may be breathing through the mouth or are keeping the mouth open merely from habit. Nocturnal mouth breathing, in particular, may continue even after the obstructing adenoids have been removed (Goadby,[14] James,[26] Strang,[27] Udd-

26. James, W. W. Simple gingivitis. Brit. D. J. 55: 551 (Dec.) 1933.

27. Strang, R. H. W. A text-book of orthodontia. Philadelphia, Lea & Febiger, 1933, p. 117.

strömer,[15] Giacometti,[28] Sprawson,[29] Matthews).[30] The responsibility of the surgeon, therefore, does not end once the obstructive adenoids have been removed or the congestion has been relieved. It is often necessary to re-educate the child to nasal breathing after adenoidectomy. The use of a mouthscreen, worn during sleep, is effective for this purpose (James,[31] Sprawson,[29] Giacometti,[28] Matthews,[30] Massler and Zwemer).[32]

Imitation • It has been suggested by James and Hastings[16] that, in the absence of demonstrable obstructions, imitation of other members of the family may be responsible for the habit of mouth breathing. This point should be more carefully investigated.

Open-mouth Habit • A lack of lip-seal or an open-mouth habit in children is common, especially during sleep. However, this does not necessarily indicate that the child is breathing through his mouth (James and Hastings,[16] Birdsall).[33] Nonetheless it might be assumed that the open-mouth habit may lead to mouth breathing, simply because in that position it is easier to breathe through the mouth than to breathe nasally (Uddströmer,[15] Giacometti).[28]

Nasal breathing is, however, a primary instinct in children. Many children who habitually keep their mouths open are not actually breathing through the mouth. Whether the breathing is oral or nasal, however, the lack of lip-seal may itself cause some or even all of the dental ill effects which are attributed to mouth breathing (James and Hastings).[16]

Dorsal Head Sleeping Position • The habit of sleeping with the head thrown back in a dorsal position is common in mouth breathers (Schwarz,[34] Wankewicz quoted by Giacometti).[28] This type of strained sleeping position may serve to perpetuate an open-mouth habit and a Class II relation of the mandible.

THE EFFECTS OF MOUTH BREATHING ON THE RESPIRATORY SYSTEM

Nose and Paranasal Sinuses • Obstructive inflammatory changes in the nasal mucosa, if they are chronic and prolonged, eventually will lead to habitual mouth breathing, especially in the narrow-faced individual. Clinical observations have suggested that the converse is also true; that habitual and prolonged mouth breathing may itself initiate serious inflammatory changes in the nasal mucosa. Many clinicians believe that in mouth breathers "the turbinates become swollen and engorged. The nasal mucosa becomes atrophic from disuse, and the alae nasi become narrow and pinched. The speech acquires a nasal tone. The bacteriostatic action of the nasal secretion is lost, and a pathway is permitted whereby disease, particularly virus infections, may enter. The sense of smell is dulled along with taste sensations and the appetite. The lymphoid tissues become hyperplastic from venous stasis and the impact of cold, dust-laden air. Occasionally, such hyperplasia of the adenoids will occlude the opening of the eustachian tube and result in defective hearing and recurrent attacks of otitis media" (Poncher, Schour and Massler).[19]

However, other observations indicate that mouth breathing does not invariably cause inflammatory or degenerative changes in the nasal mucosa. Patients

28. Giacometti, F. Die Vorhofplatte: ein beitrag zur Therapie der Mundatmung and zur kausalen Therapie und Prophylaxe des Distalbisses. Ztschr. f. Stomatol. 44:217 (May), 271 (June) 1947.

29. Sprawson, E. C. Foods and feeding as they affect teeth and their environment. Brit. D. J. 83:227 (Dec. 5) 1947.

30. Matthews, E. A mouth screen for use after adenoidectomy. Brit. M. J. 2:223 (July) 1948.

31. James, W. W. The cure of mouth-breathing. Proc. Roy. Soc. Med. (Odont. Sect.) 6: Part II, 97 (Jan.) 1913.

32. Massler, M., and Zwemer, J. D. Mouthbreathing: II: diagnosis and treatment. In press, 1951.

33. Birdsall, S. E. Diagnosis and treatment of sinusitis in children. Proc. Roy. Soc. Med. 37:403 (June) 1944.

34. Schwarz, A. M. Prophylaxis and early treatment of malocclusions. Fortschritte Orthodontik 1:635 (Oct.-Dec.) 1931.

with posterior choanal atresia must of necessity breathe through the mouth. Such cases do not show inflammatory changes in the nasal structures (Proetz).[1] Fetissow[35] reported that in several patients in whom nasal breathing had been in abeyance from three to six years because of palatal adhesions or cicatricial obstruction of the nostrils, the ciliated epithelium of the mucosa was found to be perfectly normal. Recurrent otitis media and defective hearing, apparent dullness of mentality and other symptoms often associated with "adenoid facies," may well be the result of the same chronic nasopharyngitis which also caused the mouth breathing. From the review of literature, it was obvious that speculation and clinical "impressions" dominated the thinking in this field. Carefully controlled clinical and experimental observations on the effects of mouth breathing on the nasal structures should be made in order to clarify the cause and effect relationships. Actually it is not known up to this time which comes first, the rhinitis or the mouth breathing.

Lower Respiratory Tract • In prolonged, complete mouth breathing, the important functions of the nose as an air-conditioner and air-filter must be performed by the remainder of the respiratory tract. In such instances the larynx may become burdened with inspissated secretions (Proetz).[1] Sprawson[29] considered that mouth breathing created a strong predisposition to bronchitis by permitting cold and dust-laden air to enter the respiratory tract. He stated that it was well known that many persons with bronchitis slept with their mouths open, implying that the latter caused the former. It might also be supposed that the bronchitis caused the mouth breathing.

A search of the literature did not reveal any acceptable statistical evidence that mouth breathing predisposes to infections of the lower respiratory tract.

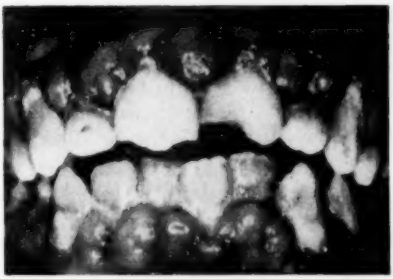


Fig. 5 • Gingivitis caused by mouth breathing in an adolescent boy

Nonetheless this hypothesis seems logical and is probably true.

THE EFFECTS OF MOUTH BREATHING ON THE ORAL STRUCTURES

Gingivitis • There seems to be a consensus that mouth breathing is an important factor in the production of gingivitis. Colyer and Sprawson[36] wrote, " . . . anterior marginal gingivitis in a child is almost pathognomonic of mouth breathing . . ." James[26] stated that ". . . so-called mouth breathing . . . is the most significant of all the factors contributing to gingivitis. This contention can be supported by the excellent results obtained by treatment."

"Mouth breathing gingivitis" is usually described as a chronic marginal gingivitis showing a pronounced tendency to hypertrophy or hyperplasia (Fig. 5). The tendency to gingival hypertrophy is strong in children but much less evident in adults (Hirschfeld).[37] The hypertrophy may be caused by edema but in most

35. Fetissow, A. G. Die Wirkung der Ausschaltung der Nasenatmung auf die Struktur der Nasenschleimhaut. Acta oto-laryng. 21:322, 1934.

36. Colyer, J. F., and Sprawson, E. C. Dental surgery and pathology, ed. 7. New York, Longmans, Green & Co., 1938, p. 507.

37. Hirschfeld, I. The toothbrush: its use and abuse. New York, Dental Items of Interest Pub. Co., 1939, p. 105, 118.

cases is a true hyperplasia. At the junction of the edematous with the normal tissue on the labial side, a pronounced "gum ridge" or "mouth breathing line" may be found. This line marks the limit of the area exposed to the air when the mouth is in the rest position with the lips apart. On the assumption that lack of pressure from the lips and cheeks is in part responsible for the edematous condition of the marginal gingiva, James and Hastings[16] termed these gum ridges "tension ridges."

Hirschfeld[37] described the condition in adult mouth breathers as follows:

> Hypertrophic gingivitis is much less likely to occur [in adults] than in children. Instead, a marginal gingivitis, with or without an edematous condition usually develops on the palatal sides of four or six anterior teeth . . . , even in the presence of hygiene. The color is generally bright red, not unlike that of the gingivitis produced by lack of function and hygiene. The surface of the marginal gingiva, as well as the rest of the palate is glossy and becomes dry rapidly when the mouth is opened for inspection. . . .
>
> Not infrequently, however, only the labial gingiva becomes hypertrophied, especially when shortness of the lips causes its continual exposure to the air. At other times, the hypertrophy may extend from the anterior part beyond the bicuspids to the molars, in the form of an interproximal hypertrophic gingivitis—possibly an indication that the bacterial element is an important factor in spreading the condition.

Mouth breathing gingivitis may be the result of the desiccation of the gingival epithelium, accumulation of debris caused by lack of salivary and labial action, and bacterial growth, all of which produce chronic inflammation (Goadby).[14] A change in the oral flora in over 200 patients suffering from hyperplastic rhinopharyngostomatitis was reported by Fox and Kesel.[22] Cold air impinging on the exposed gingiva causes vasoconstriction and increases the susceptibility of the tissue to infection (Spicer).[38] It should be pointed out, too, that all of these factors may operate in the absence of actual mouth breathing if an open-mouth habit exists (James).[26]

Periodontal Disease • Chronic gingivitis usually leads to more severe periodontal disease. A high incidence of periodontal disease should therefore prevail in persons who breathe through the mouth. Several investigators have noted this association (James).[31] Goadby[14] stated " . . . not a few cases of the early loss of teeth due to pyorrhea alveolaris in young adults may be traced to nasal obstruction followed by hypertrophic gingivitis."

Coated Tongue • The drying effect of mouth breathing on the oral structures is seen early on the tongue. The chronic mouth breather often complains of a bad taste in the mouth in the morning which is associated with a coated tongue and fetor ex ore (Fox and Kesel).[22]

Dental Caries • It has been suggested that mouth breathers are more liable to dental caries (Spicer).[38] Gibson[39] noted that "white decay is always present" in mouth breathers. Reduction in the cleansing action of the lips and saliva was held responsible for this (Leimgruber).[40] Dickin[41] stated that treatment with an oral screen reduced the incidence of caries. However, no controlled studies on the incidence of caries in mouth breathers have been reported. The short life of synthetic porcelain fillings in mouth breathers sometimes is ascribed to the drying out of the cement (Skinner).[42]

Treatment • It is possible that many of the changes mentioned may result from

38. Spicer, Scanes. On nasal obstruction and mouth breathing as factors in the etiology of caries of the teeth, and in the development of the vaulted palate. Brit. J. Den. Sc. 33:193 (March) 1890.

39. Gibson, C. M. Part time mouth breathing and periodontoclasia. J. Periodont. 12:24 (Jan.) 1941.

40. Leimgruber, C. Kariesprophylaxe. Schweiz. Monatsschr. f. Zahnh. 55:1003 (Dec.) 1945.

41. Dickin, H. O. Oral screens in the treatment of certain dental irregularities. Proc. Roy. Soc. Med. (Odont. Sec.) 27:1411 (Aug.) 1934.

42. Skinner, E. W. The science of dental materials, ed. 3. Philadelphia, W. B. Saunders Co., 1946, p. 165.

the drying of the oral and pharyngeal mucosa during mouth breathing. Many clinicians have successfully treated the chronic gingivitis resulting from the open-mouth habit, with or without mouth breathing, by the use of an oral screen worn at night (James,[26,31] Peacock and Cook,[43] Bliss,[44] Robertson,[45] Giacometti,[28] Massler and Zwemer).[32] Taping the mouth at night (Richter)[46] also has been successful, especially when other methods of treatment, breathing exercises, thorough toothbrushing and gingival massage, (Hirschfeld,[37] Lite)[47] were included.

EFFECTS OF MOUTH BREATHING ON THE GROWTH OF THE FACE

Certain authorities consider that chronic mouth breathing seriously affects the development of the entire facial skeleton of the child. This aspect of the literature has been summarized as follows:[19]

> In the child whose normal nasal function is obstructed so that he is obliged to breathe through his mouth, the following changes occur:
>
> The lips become slack and stay open so that the upper lip is shortened and leaves the upper incisors exposed, while the lower lip becomes heavy and everted and usually lies beneath and behind the upper incisors instead of over them. The molding action of the lips on the upper incisors is thus lost, and a protrusion of these teeth, with spacing, results.
>
> The tongue is kept suspended between the arches or on the floor of the mouth instead of on the roof, so that the molding action of the tongue is lost to the upper buccal segments, leaving them unopposed to the action of the buccal musculature.
>
> The maxillary arch and the maxillae become V-shaped due to contraction of the buccal segments and protrusion of the anterior teeth. The palate seems high as a result of the contraction of the alveolar arches.
>
> The mandible is retruded and hangs open in a slack manner. The tongue and lips keep this arch from collapsing.
>
> The maxillary sinuses and nasal cavity frequently become narrowed as the upper arch is contracted, with further narrowing of the face."[19]

"Adenoid Facies" • The foregoing quotation describes most of the features of the so-called "adenoid facies" in which the lower face is expressionless, the nose long and thin against the less prominent cheek bones, the upper lip short and everted, the lower lip thickened and pendulous and the chin receded (Fig. 4). The "adenoid facies" has been associated with deafness and even with retarded mental development (Ballenger).[23]

Yet definite evidence of a cause and effect relationship between mouth breathing and maldevelopment of the face of the so-called "adenoid facies" type is difficult to find. What has been noted is that many patients with the "adenoid facies" are mouth breathers (Whitaker).[48] It has not been shown that mouth breathing produces the "adenoid facies." Lederer[49] wrote, "It is a moot point whether the adenoids produce changes in the skeleton because of nasal obstruction, or whether the changes in the skull are primary and developmental in character." This question remains open to date.

Malocclusion of the Teeth • It became apparent early in this review that there are two schools of thought regarding the importance of mouth breathing in the etiology of malocclusion. One group considers that changes in muscular forces, while the mouth is held open during

43. Peacock, H. M., and Cook, C. C. The general and dental results obtained by the control of breathing. New Zealand D. J. 33:214 (July) 280, (Sept.), 356 (Nov.) 1937, 34:5 (Jan.) 1938.

44. Bliss, Dennis. The mouth screen and its use in orthodontics. New Zealand D. J. 39:240 (April) 1943.

45. Robertson, T. M. Fabricating appliances with electric spot welder. Am. J. Orthodont. & Oral Surg. 32:281 (May) 1946.

46. Richter, J. W. Hypertrophic gingivitis of mouth breathing. U. S. Nav. M. Bull. 45:1147 (Dec.) 1945.

47. Lite, Theodore. Mouth breathing: a contributing factor in the etiology of gingival irritation. J. D. Med. 4:13 (Jan.) 1949.

48. Whitaker, R. H. R. The relationship of nasal obstruction to contracted arches and dental irregularities. Dentist's Record 31:425 (July) 1911.

49. Lederer, F. L. Diseases of the ear, nose and throat, ed. 5. Philadelphia, F. A. Davis Co., 1946, p. 606.

mouth breathing, are a primary factor in the development of a typical Class II, division 1 (Angle) type of malocclusion. Another group holds that the malocclusion is not the result of mouth breathing but the result of genetic factors and is characteristic of that individual and his facial type. They consider the mouth breathing as either unrelated to the malocclusion or, at most, only an aggravating factor.

Mouth Breathing the Cause of Malocclusion • As early as 1872, Charles Tomes[50] stated that V-shaped, contracted jaws were generally found in association with greatly enlarged tonsils which necessitated mouth breathing. He considered that the physical forces at work—namely, the open lips and relaxed tongue—were sufficient to account for all the phenomena observed. This view, with enlargement of the pharyngeal rather than palatine tonsils being stressed, has found many advocates. Angle,[51] describing his Class II, division 1 type of malocclusion, wrote: "This form of malocclusion is always accompanied and, at least in its early stages, aggravated, if indeed not caused, by mouth breathing due to some form of nasal obstruction." He also suggested that even temporary mouth breathing occurring at the time of eruption of the first permanent molars might cause malrelation of these teeth because of distal placement of the mandible. Giacometti[28] has also emphasized the disastrous effects of mouth breathing on the labile, erupting incisors. It is clear that any mechanical influence would have its greatest effect during the susceptible, mixed dentitional period (6 to 12 years of age).

The action of the intraoral and extraoral musculature is considered by adherents to this thesis to be abnormal during mouth breathing. The upper posterior teeth are deprived of the support of the tongue on the inside, permitting the buccal musculature to rest unopposed on the outside, thus causing a contracture of the upper arch and palate. The upper lip is flaccid and does not resist the forward movement of the upper anterior teeth so that they become protrusive. The lower lip, as a result, also fails to bind in the upper incisors and instead becomes tucked under and behind these teeth and further promotes their forward protrusion (Lischer,[52] Strang,[27] Bowen and Balyeat,[53] Neivert,[13] Ballenger,[23] McCoy).[54] (Fig. 4). This effect is particularly noticeable during the mixed dentitional period (6 to 12 years).

Dorsal Head Sleeping Position • Wankewicz (quoted by Giacometti),[28] Schwarz[34] and others emphasize the influence of the dorsal head position during sleep on the production of a distal position of the mandible and a Class II malocclusion. It has been noted often that children who breathe through the mouth also tend to sleep with the head thrown back in a dorsal position almost as in opisthotonos. The pull of the suprahyoid muscles on the mandible tends to create a Class II malocclusion. These investigators feel that the nine sleeping hours in this position are more important than the intermittent mouth breathing during the day.

Mouth Breathing Not the Cause of Malocclusion • While the foregoing description carries the conviction of logic, opposition to this view of the cause and effect of mouth breathing has not been wanting. Many observers have reported that the "adenoid facies" is not always associated with mouth breathing and that not all

50. Tomes, C. S. On the developmental origin of the v-shaped contracted maxilla. Month. Review D. Surg. 1:2, 1872.

51. Angle, E. H. Treatment of malocclusion of the teeth, ed. 7. Philadelphia, S. S. White Dental Manufacturing Co., 1907, p. 46.

52. Lischer, B. E. Principles and methods of orthodontics. Philadelphia, Lea & Febiger, 1912, p. 69, 71.

53. Bowen, R., and Balyeat, R. M. Facial and dental deformities due to perennial nasal allergy in childhood. South. M. J. 27:933 (Nov.) 1934.

54. McCoy, J. D. Applied orthodontics, ed. 6. Philadelphia, Lea & Febiger, 1946, p. 103.

mouth breathers have a Class II type of malocclusion. As early as 1888, Kingsley[55] stated that he could not accept the view that muscular contraction of the cheeks could produce a contraction of the palate. He felt that the V-shaped palate was inherited and not acquired through mouth breathing. McKenzie,[56] reporting on his examination of 222 children with adenoids, noted that over 40 per cent had normal palates. Brash[20] also found that deformed palates often occurred in children who never had adenoids. Whitaker[48] reported similar findings after the examination of 800 patients who had been operated on for adenoids. Sillman,[57] in 1942, reporting on serial studies from birth to 5 years of age, expressed the opinion that mouth breathing does not appear to be a primary cause of malocclusion.

These views have been confirmed further by other studies. Huber and Reynolds[58] examined 500 male students and discovered, on questioning, that 27 were mouth breathers. On examination of these 27, they found that the occlusion of one was anatomically correct; 16 cases were Class I, 8 were Class II, and two were Class III (Angle's classification). Howard[59] examined 500 patients with histories of enlarged faucial tonsils. He found that 159 were definite mouth breathers. Of these, 59.1 per cent had a normal occlusion, 21.3 per cent of the cases were Class I, 13.9 per cent were Class II and 5.7 per cent were Class III. These results would seem to show a fairly average distribution. Hartsook,[60] in a review of the literature, came to this conclusion, "It is evident . . . that mouth breathing is not a primary etiologic factor in the production of malocclusion, and, that the occlusions of mouth breathers are distributed among all types of occlusions, rather than being limited to one particular or classic type of malocclusion." Sim Wallace,[61] at the end of his chapter on mouth breathing, summed up this point of view by saying, "Taking all the facts together, we are bound to admit that there is but little evidence of a causal relationship between adenoids and the type of jaw deformity which used to be ascribed to the tension of the lips and cheeks on the dental arch as the result of mouth-breathing." Whitaker[48] pointed out that while mouth breathing and malocclusion may occur concomitantly, they are not necessarily causally related.

Mouth Breathing, Malocclusion and Facial Type • The two opposing points of view can be reconciled on the basis that mouth breathing is injurious only to the narrow-faced individual who already possesses a narrow arch—one which can be further contracted easily by slight abnormalities in muscular forces. In the broad-faced individual on the other hand, the effects of mouth breathing would be absent (Fig. 6).

In 1932 James and Hastings[16] came to the conclusion that the "adenoid facies" and the open-mouth habit occurred in "a particular type of individual." Our own observations tend to support the view that mouth breathing does accentuate a Class II division 1 type of malocclusion, but only in the genetically narrow-faced and narrow-arched individual with a strong natural tendency in this direction. Broad-faced individuals are seldom subject to mouth breathing and,

55. Kingsley, N. W. A treatise on oral deformities as a branch of mechanical surgery. New York, D. Appleton Co., 1888, p. 10-13.

56. McKenzie, Dan. Adenoids, deformities of the palate, and artificial infant feeding. An analysis of 222 cases. Brit. D. J. 30:159, 1909.

57. Sillman, J. H. Malocclusion in the deciduous dentition: serial study from birth to five years. Am. J. Orthodont. & Oral Surg. (Ortho. Sect.) 28:197 (April) 1942.

58. Huber, R. E., and Reynolds, J. W. A dentofacial study of male students at the University of Michigan in the physical hardening program. Am. J. Orthodont. & Oral Surg. (Ortho. Sect.) 32:1 (Jan.) 1946.

59. Howard, C. C. Inherent growth and its influence on malocclusion. J.A.D.A. 19:642 (April) 1932.

60. Hartsook, J. T. Mouth breathing as a primary etiologic factor in the production of malocclusion. J. Den. Children 13:91 (4th quarter) 1946.

61. Wallace, J. Sim. Variations in the forms of the jaws. New York, William Wood & Co., 1927, p. 173-174.

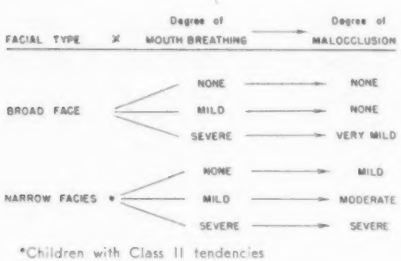


Fig. 6 • Diagram showing the effects of mouth breathing in different facial types

when it does occur, seldom suffer these consequences (Weidmann).[28]

Even in the absence of mouth breathing, the narrow-faced individual has a strong tendency to a contracted palate and a Class II division 1 type of malocclusion (Herbst).[62] In other words, it might well be that mouth breathing is merely a precipitating factor which brings forth a latent genetic tendency to a narrow arch and Class II division 1 malocclusion (Fig. 6). Mouth breathing does not necessarily create the "adenoid facies." Further exploration of the relation of mouth breathing to the facial type of the individual is necessary to clarify the issue.

Development of the Sinuses • Some authors consider that continuous obstruction to nasal breathing causes a lack of development of the paranasal sinuses (Dickin,[41] Neivert).[13]

James and Hastings[16] reported that in 180 cases of congenital choanal atresia reported in the literature, some had frontal and maxillary sinuses which were normal in size. When abnormalities did occur, they were not as pronounced as in "adenoid facies" and may have been caused by the same conditions which produced the choanal atresia.

There is, in fact, no evidence in the literature to show that lack of nasal function interferes with the resorption of bone by which the sinuses enlarge (Brash).[20] Nor is there any evidence that the growth of the facial bones is affected by a lack in the development of the sinuses. A well-developed facial skeleton may be associated with small sinuses. A patient with large supraorbital ridges may have small frontal sinuses or they may be nonexistent, as, for example, in cases of arachnodactylia. Therefore, it must be concluded that although often reiterated, it has not been shown that the growth of the sinuses is affected by mouth breathing or by chronic nasal obstruction.

THE EFFECTS OF MOUTH BREATHING ON GENERAL HEALTH

Many authorities believe that if mouth breathing is continued over a long period of time it interferes with the general health and nutrition (Osler and McCrae).[63] Neivert[13] summarized this viewpoint and indicated that the basic cause was an insufficient oxygenation of the blood. Anoxemia may lead to perverted metabolism, restlessness at night and poor appetite, all of which factors affected the growth of the body structures. Dickin[41] and Peacock and Cook[43] stated further that reintroduction of normal nasal respiration produced a surprising improvement in the whole physique. On the other hand, it has been shown that many children who practice mouth breathing do not suffer from obvious physical defects (Humphreys and Leighton).[64]

The development of a keel-shaped chest, or funnel-shaped deformity of the chest, has also been attributed to mouth

62. Herbst, E. Uber Retentionsapparate. Ztschr. f. Zahnärtzliche Orthopädie 4:172 (April) 1910.

63. Osler, W., and McCrae, T. The principles and practice of medicine, ed. 9. New York, D. Appleton & Co., 1920, p. 460-463.

64. Humphreys, H. F., and Leighton, B. C. A survey of antero-posterior abnormalities of the jaws in children between the ages of two and five and a half years of age. Brit. D. J. 88:3 (Jan. 6) 1950.

breathing (Osler and McCrae,[63] Ballenger[23] and Poncher, Schour and Massler).[19] Sprawson[29] pointed out that such chest deformities were not seen in mouth breathers unless rickets was also present. He believed that the rickets, associated with the mouth breathing, produced the pidgeon breast.

At various times it has been suggested that mouth breathing is associated with anemia, mental retardation (possibly because of defective hearing), stammering, globus hystericus, enuresis and even grinding of the teeth (Osler and McCrae,[63] Ballenger).[23] However, no evidence has ever been produced in support of such statements.

Conclusion • While clinical case reports on the deleterious effects of mouth breathing are not lacking, (Davidsohn,[65] Korbitz quoted by Giocometti)[28] no controlled studies of the nutritional status or the rate of growth of mouth breathers as compared with children who breathe normally could be found. Therefore, the hypothesis that general nutrition and growth are affected by mouth breathing, cannot be considered as proved. However, the thesis that mouth breathing renders the individual more liable to airborne infections would seem a logical deduction.

SUMMARY

Although there is considerable literature on the subject of mouth breathing, only the causes of mouth breathing have become clarified. The effects of mouth breathing are still a matter of controversy. This is particularly true of the effect of mouth breathing on the development of the face and jaws. Recent observations suggest that too much importance has been attached to mouth breathing per se as the etiologic factor in maldevelopment of the face and jaws and not enough to the predisposing genetic factors. This is also true of the relation of mouth breathing to malocclusion of the teeth. Probably few, however, would maintain that the effects of mouth breathing are always negligible. There is apparent agreement that mouth breathing, or the open-mouth habit, may lead to certain types of gingivitis. However, the exact mechanism by which this occurs and its relative importance in the general picture of gingivitis is not clear.

It would seem that further experimental and clinical studies are necessary before the controversial issues concerning the effects of mouth breathing can become clarified.

65. Davidsohn, E. Mund-und Nasenatmung. Deutsche Monatschr. f. Zahnh. 38:504, 1920.

A Specialist • The definition of a specialist as one who "knows more and more about less and less" is good and true. Its truth makes essential that the specialist, to do efficient work, must have some association with others who, taken altogether, represent the whole of which the specialty is only a part. *C. H. Mayo, "Surgery's Problems as They Affect the Hospital," Modern Hospital 51:68, September, 1938.*

Dynamic models for patient education

Marvin Simring, D.D.S., Brooklyn

Patient education has become an integral part of effective dental treatment.[1] Properly educated patients are eager for and capable of that cooperation which may make the difference between success and failure in treatment.[2]

Visual aids have long been known and utilized by the dental profession.[3] The dynamic model combines both visual and tactile sensation. By utilizing patient participation with these sensory appeals, the dynamic model can become an ideal aid toward perception and understanding of complex dental procedures. "The effects may be arrived at mathematically," Barrett[4] has stated, "but actual illustrations make the conditions most readily understandable."

To this end three dynamic models were constructed which can be used to present to the patient many phases of occlusal equilibration or adjustment and can also be used as aids in presenting the etiology, course, prognosis and treatment[5] of periodontal disease.

Models with elastic materials representing the periodontal membrane have been used heretofore in the study of changes within the periodontal membrane as a result of stress applied to the teeth. Schwartz[6] constructed models using rubber bands to represent the periodontal membrane. The author later used rubber dam as the elastic material. Sorrin (with the author's collaboration) constructed a model, utilizing sponge rubber as the elastic, illustrating both tension and compression, which the earlier models lacked, in order to study and demonstrate periodontal membrane changes resulting from occlusal stress. Barrett[4] used polarized light with a special photoelastic material representing the periodontal membrane to visualize exact sites of compression and tension.

All of the models described, or any models that ingenuity can devise, are of value. The three models to be described are chosen for their wide scope of usefulness, their simplicity, and because they illustrate how to use such models rather than which models to use.

These models are easily constructed out of materials which are available in every dental office or which can be purchased readily. They all represent a tooth or teeth, constructed of cardboard or balsa wood, attached with staples to the periodontal membrane which is made of rubber dam and which is also attached with its own staples to the alveolar socket.

Instructor, periodontia department, New York University College of Dentistry, New York.

1. Blass, J. L., and Tulkin, I. Successful dental practice. Philadelphia, J. B. Lippincott Co., 1947.

2. Friend, D., and others. The dentist and his patient. New York, Revere Publishing Co., 1945.

3. Regli, C. P. Schematic drawings for illustrating technical procedures. J. D. Educ. 13:145 (March) 1949.

4. Barrett, C. E., Jr. Studies on: the use of gelatin-glycerine mixtures in determination of stress analysis by polarized light and electronic amplification of occlusal sounds. J. D. Med. 5:8 (Jan.) 1950.

5. Simring, M. Correlation of treatments for the periodontal pocket. J. D. Med. 3:78 (July) 1948.

6. Schwartz, A. M. Movement of teeth under traumatic stress. D. Items Interest 52:96 (Feb.) 1930.

The socket also is made of cardboard or balsa wood. In order to prevent forward and backward play, a flat piece of glass or transparent plastic covers the root portion of the model with a flat board or other support behind it.

With these models, the patient, or student, immediately perceives a broader scientific foundation for modern dentistry in its relation to basic sciences and universal laws of physics and engineering than he had previously imagined. This gives the patient a fuller appreciation of the fundamental value of the prescribed services. He is enabled to see what happens to the periodontal membrane when pressure is applied to his teeth in chewing, swallowing, or through an occlusal habit, and he is enabled to feel what happens to the tooth's stability and resistant powers as, under the doctor's supervision, he changes the site or direction of application of stress to the "tooth." Used in conjunction with the patient's roentgenograms, study casts and clinical photographs, the conditions which apply specifically to him can be analyzed and be made readily comprehensible.

MODEL 1

The simplest model (Fig. 1) is constructed as described earlier. If cardboard is used for the rigid parts (tooth and alveolar bone), it may be necessary to paint on several layers of a watery mix of dental stone in order to add rigidity and to obscure the staples. The model may be painted to look like a tooth in its socket, or paper drawings of tooth and bone may be pasted over each of these parts. If balsa wood is used the staples are best obscured by pasting pieces of paper, cut to size, over the tooth and over the alveolus, respectively. The model, illustrated in Figure 1, has the histologic structure of the tooth drawn on it to aid in the visualization by the patient.

The dimensions used are those described by Wheeler[7] for an upper second bicuspid. It is necessary to exaggerate the relative width of the periodontal membrane in order to make the changes readily visible. The periodontal membrane is 4 mm. wide or 20 times scale[8] while the tooth is three times scale.

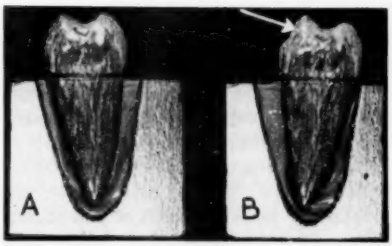


Fig. 1 • Model 1. A: Tooth at rest. B: Tooth pushed laterally

It is basic to all of these models that the greater the amount of force transmitted to the periodontal membrane (rubber dam), the more it will yield. Thus changes of force in the rubber periodontal membrane are readily visualized as changes in the width of the rubber dam and also as changes in the resultant movement of the tooth. Therefore, (1) when a particular part of the rubber dam (periodontal membrane) yields most, that part is under greatest strain and (2) when, as a result of change in applied (occlusal) stress, the tooth appears to be looser than it was before the change, it signifies that greater strain has developed in the supporting rubber (periodontal membrane) to cause it to yield more.

USES AND CLINICAL SIGNIFICANCE

1. When the patient is told to press the model tooth laterally, he will find that it tilts as shown in Figure 1,B.

7. Wheeler, R. C. Tooth form. Philadelphia, W. B. Saunders Co., 1939, p. 5.

8. Kronfeld, R. Histopathology of the teeth, ed. 3, revised by Boyle, P. E. Philadelphia, Lea & Febiger, 1949, p. 370.

Explaining Etiology • If the patient suffers from occlusal trauma of this type, he can see how the cervical region receives the brunt of the periodontal strain[9] since the greatest change in shape of the periodontal membrane occurs here. The resultant tissue trauma and circulatory interference may initiate or aggravate the local inflammatory process of periodontal disease.[10] Thus the site of initial bone changes, at the crest of the alveolus, may be partially explained on the model and indicated in the patient's roentgenograms.

2. When the model is pressed vertically into its socket the tooth will appear tighter than when pressed laterally.

Explaining Treatment • The dentist explains that this shows how horizontal occlusal stresses, resulting from malposed teeth or steep cusp inclines, produce great periodontal strain as compared to vertical occlusal force. The patient can then see why it is necessary to decrease the horizontal component of occlusal stress by reshaping his teeth and making their guiding cusp inclines shallower.[11]

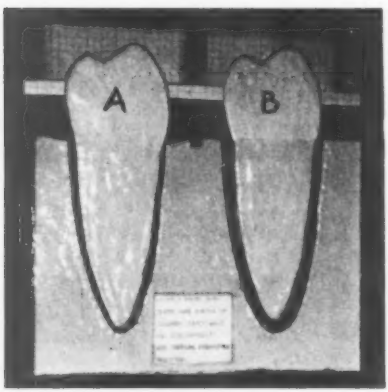


Fig. 2 • Model 2. A: Healthy periodontal membrane. B: Inflamed, swollen periodontal membrane

3. When the tip of the cusp is pressed vertically the tooth will tilt somewhat. However, if the same vertical pressure is applied at the central fossa, then the tooth moves vertically into its socket instead of tilting and the tooth feels tighter and more resistant.

Explaining Etiology • Where occlusal stress falls far from the center of the tooth, for example, with extremely broad or worn or tilted teeth, it produces greater periodontal strain, especially cervically and apically.[12]

Explaining Treatment • Where this clinical entity prevails, the advantage of narrowing the buccolingual diameter of the tooth can be made apparent to the patient.[13]

4. When the tooth is pressed laterally at the occlusal tip, it will tilt more than when the same lateral pressure is applied nearer the cervical line.

Explaining Etiology • Long or extruded teeth may induce excessive periodontal strain, especially cervically.[14]

Explaining Treatment • Grinding the teeth, in harmony with occlusal equilibration, will increase their periodontal stability.

MODEL 2

This model (Fig. 2) differs from Model 1 since two teeth are used instead of one.

9. Christensen, F. G. A review of "clinical review of pyorrhea." Brit. D. J. 66:3 (Jan.) 1939.

10. Bell, D. G., and others. The periodontal lesion (Part I). J. Periodont. 21:748 (Jan.) 1950.

11. McCall, J. O. The relationship of cusp inclination to alveolar integrity. Ortho. & Oral Surg., Int. Jnl. 11:404 (May) 1925.

12. Hay, G. E. Stress in the periodontal membrane. Oral Health 29:257 (April) 1939.

13. Sorrin, S. Traumatic occlusion, its detection and correction. D. Digest 40:170 (May); 202 (June) 1934.

14. Schuyler, C. H. Fundamental principles in the correction of occlusal disharmony, natural and artificial. J.A.D.A. 22:1193 (July) 1935.

One of these two teeth is mounted so that its periodontal membrane is double the width of the other one. The teeth illustrated in Figure 2 are lower first bicuspids, nine times scale; the periodontal membranes are 20 times and 40 times scale or 4 mm. and 8 mm. wide, respectively.

A backboard is provided on which is mounted millimeter-ruled graph paper. The number of squares one tooth moves can be compared with the movement of the other tooth under equal occlusal stress. Likewise, the stresses, which will produce a given amount of movement, can be compared. Furthermore, this model permits comparison of the occlusal stress: periodontal strain ratio, not only between the two teeth but also between differently directed stresses on any one tooth; that is, lateral and vertical stress.

It must always be emphasized that the movements of these models do not represent the actual movements of actual teeth such as occur in orthodontics, but are merely diagrammatic representations of the strains that develop in the periodontal tissues under occlusal stress.

USES AND CLINICAL SIGNIFICANCE

1. By itself, either tooth is the equivalent of Model 1 and may be utilized for the same purposes.

2. With the double model the dentist can explain that Tooth A (Fig. 2) represents a tooth in health. The periodontal membrane is thin and mobility is very slight. Clinically, tooth mobility is generally imperceptible in health. Periodontal inflammation involves swelling which is indicated in the roentgenogram by thickening of the periodontal space. Tooth B represents the periodontally diseased tooth with the swollen periodontal membrane.

When the patient pushes these teeth he will find the healthy tooth (A) much tighter than the diseased tooth (B).

Explaining Etiology • (Tooth A) Inflammation of the periodontal membrane, with resulting widening of the periodontal space, can increase the mobility of a tooth to the point where it becomes clinically perceptible.[15] (Tooth B) The swelling of a soft tissue (periodontal membrane) wedged between two hard structures (bone and tooth) may explain the subjective sensations of "tightness" and "wedging" frequently associated with periodontal disease.

Explaining Treatment • Teeth can be tightened by periodontal treatment which alleviates the inflammation permitting the periodontal membrane to return to its normal thinness.

Explaining Prognosis • Where the mobility is due to other factors; for example, severe bone loss, eliminating the inflammation by itself may be inadequate to restore functional stability and the tooth may require splinting or extraction.[16]

MODEL 3

This model (Fig. 3 and Fig. 4, A and 4, E) represents the lower first and second bicuspids in contact. They were constructed nine times scale and the periodontal membrane was made 40 times scale or 8 mm. wide. The periodontal membrane is the same thickness throughout. The two teeth are compared on the basis of distribution of periodontal support. The first bicuspid is attached to periodontal membrane halfway up the root. The second bicuspid has the same amount of attachment, but it is attached very high mesially and very low distally. In order to delineate the periodontal membrane sharply, the back of the model was boxed in and two flashlight bulbs

15. Kronfeld, R. Histopathology of the teeth, ed 3. Philadelphia, Lea & Febiger, 1949, p. 325.

16. Miller, S. C. Textbook of periodontia, ed. 3. Philadelphia, The Blakiston Co., 1950.

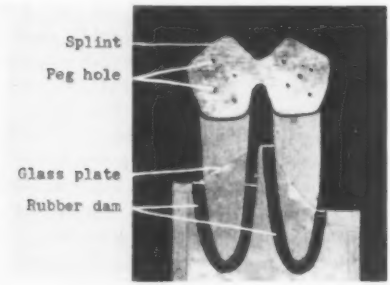


Fig. 3 • Model 3 with splint attached. Note the even height of attachment of the periodontal membrane to the root of the first bicuspid (on the left) and the uneven heights of attachment of the second bicuspid root

were wired in to provide transillumination through the rubber dam. Balsa wood was used for this model because great rigidity is required.

The splint is a piece of balsa wood cut to the shape of the two crowns in contact. It is painted gold. Each tooth has four pegs and a central hole and the splint has eight holes and two pegs to correspond. Thus the splint can be attached to the teeth providing a rigid bond between them. The pegs are made from the sticks commonly used for cotton applicators. Accurate placement is assured by pinning teeth and splint together and then drilling holes through splint and teeth. Five holes are made for each tooth. Pegs are cemented into four of the holes in each tooth. The fifth (central) hole in each tooth is left empty, but the corresponding hole in the splint has a peg cemented into it. Model airplane glue is excellent for this purpose.

USES AND CLINICAL SIGNIFICANCE

1. The second bicuspid (with uneven height of periodontal attachment) feels tighter than the first bicuspid (with even periodontal attachment). If each tooth is pressed sideways independently, each will tilt, but the first bicuspid will tilt more and the center of rotation of this tilt will be lower than it is for the second bicuspid (Fig. 4, D and 4, H).

Explaining Prognosis • Where bone loss has taken place on all sides of a tooth, the periodontal strain is greater than where alveolar atrophy is limited to one side of the tooth, even though the periodontal support may be least on that one side. This consideration may determine whether a tooth is retained or extracted or whether or not it is used as a bridge abutment.[16]

2. If the teeth are pushed individually; that is, away from the contact point, (Fig. 4, D and 4, H) they feel looser than when pushed while contact is retained; that is, toward the contact point (Fig. 4, B and 4, C).

Explaining Prognosis • Teeth in contact have a better periodontal prognosis than isolated teeth.[16]

3. When the splint is attached to both teeth they appear extremely tight as compared to their mobility without the splint. When pushed laterally, they no longer tilt as individual units about centers within each tooth; instead, both teeth tip as a single unit about a single rotational center between the two roots. (Compare Figure 4, B and 4, F and Figure 4, C with 4, G.) Thus some of the periodontal strain which results from the horizontal component of occlusal pressure is directed vertically when teeth are splinted.

Explaining Treatment • Splinting enhances the stability of loose teeth.

Explaining Prognosis • Splinting improves the prognosis of periodontally involved teeth where too much bone has

been lost for the teeth individually to withstand the functional occlusal load.

4. When the splint is attached to one tooth but not to the other it appears like a cantilever bridge. When pushed vertically at its unattached part, the tooth to which it is attached will tilt perceptibly and will appear much looser than when the same vertical pressure is applied directly to the crown of that tooth.

Explaining Etiology and Prognosis • Prosthetic restorations may tend to increase the periodontal strain of their abutments, especially near the alveolar crest.

Explaining Etiology • Cantilever bridges with only one abutment are periodontally unstable in most cases and are generally periodontal pathogens.[17]

RESTORATIVE DENTISTRY

Prosthetic dentistry may induce occlusal trauma by adding the load of false teeth to the load already being carried by the natural abutments.[18] In order to reduce the strain on these teeth the dentist may have to alter the shape of these teeth by grinding or reconstruction (gold crowns, inlays, amalgam restorations).

By using the models as already described to show how the added load of

17. Miller, S. C. Textbook of periodontia, ed. 3. Philadelphia, The Blakiston Co., 1950, p. 446.

18. Glickman, I. The periodontal structures and removable partial denture prosthesis. J.A.D.A. 37:311 (Sept.) 1948.

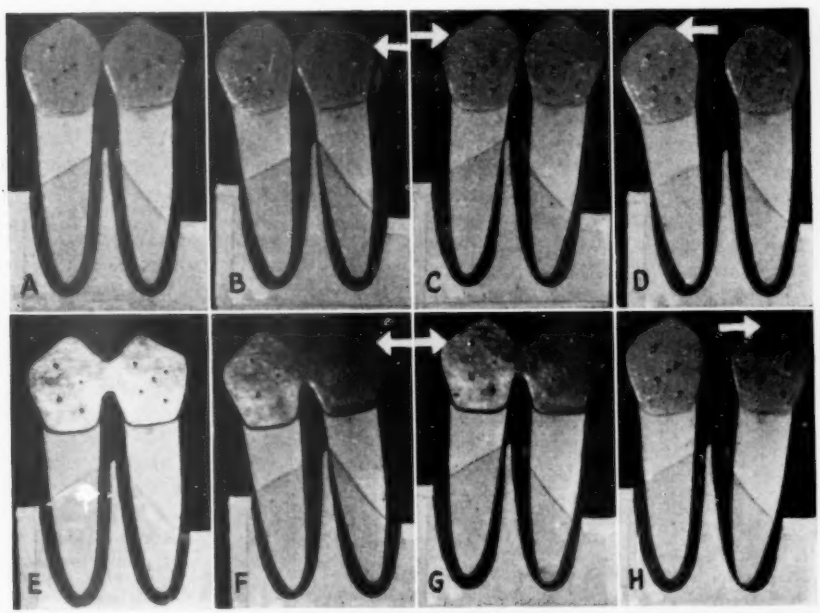


Fig. 4 • White arrows indicate general direction of lateral stress applied to Model 3. Splint is in place in E, F and G only

a bridge or denture may cause trauma, the patient can perceive why it may be necessary to make some of his teeth shorter, narrower and with shallower cusp inclines. Where applicable the patient is also enabled to see why it may be necessary to use splinting in the form of multiple abutments and, in some instances, multiple clasping or continuous clasping.

The restoration of vertical dimension (bite-raising) may produce increased periodontal strain by increasing the effective height of the clinical crown. The patient can readily perceive three means of avoiding this possible increased periodontal strain:

1. Decreasing angle of guiding cusp inclines.

2. Decreasing buccolingual diameter.

3. Splinting.

ORTHODONTICS

Following orthodontic treatment, maintenance of the positions attained for the teeth can frequently be insured by grinding the teeth to complete the equilibration of the occlusion.[11,19] Here, too, the models may be used to help patients gain insight into dental procedures.

SUMMARY

Three models have been described. They are applicable to at least 15 different points in the exposition of periodontal pathosis. Also, many uses for patient education in restorative dentistry and orthodontics were demonstrated.

Dynamic occlusion models provide easily constructed tools to help patients attain dental insight.

2566 Ocean Avenue

19. Coleman, R. E. Equilibration of occlusion in orthodontics. Am. J. Orthodont. 34:791 (Oct.) 1948.

Harmfulness of Error • No error is harmless. "Men rest not in false apprehensions without absurd and inconsequent deductions." Some of the deductions seem inconsequential as well as inconsequent, but in their larger aspects they are not. It cannot do much harm to believe that hair turns white over night, or that birds live a happy family life, or that orientals have slanting eyes: but it can do a great deal of harm to be ignorant of physiology or zoology or anthropology, and the harm that may result from forming an opinion without evidence, or from distorting evidence to support an opinion, is incalculable. *Bergen Evans, "The Natural History of Nonsense," p. 274.*

Some recent studies concerned with fundamental research on beginning caries

James Nuckolls, D.D.S.; W. E. Hutton,† Ph.D.; Valerie Hurst,‡ M.A.; H. E. Frisbie,§ D.D.S., and M. S. Marshall,‖ Ph.D., San Francisco*

A review of the many theories of dental caries shows that far too often a single mechanism has been adopted to explain the entire process of development of the lesion. This attitude can only lead to the frustrating polemic discussions so common in the literature. A great step forward can be made if this idea is abandoned and an attempt is made to integrate the many obscure and complex factors which have come to light in caries research. Clinical researches which have a sound basis must be evaluated, and, in turn, must find their explanation in fundamental laboratory studies. Laboratory researches must be critically appraised, for, though yielding sound evidence, they may not simulate actual conditions which exist in the oral cavity.

There are at present three main avenues of approach in caries research: (1) those experiments attempting to control or reduce caries by altering the oral environment, (2) those experiments attempting to control caries by application of various agents to tooth surfaces, (3) those experiments designed to discover the factors concerned in the initial phases of the disease process. It is the third approach with which this paper will be concerned since it would seem most likely to lead, ultimately, to the development of sound methods of caries prevention and control.

Because of its extensiveness, complete reviews of the literature of caries research, such as that of Bagnall,[1] are rare. A few recent investigations which are of a fundamental nature will be considered here.

Any discussion of the etiology of caries must presuppose some sequence of events in the course of the disease. Enamel development in relation to the susceptibility of the tooth is important. That plaques are deposited on enamel and may act in the inception of the carious lesion must be considered from the point of view of the action of the plaque on the tooth surface. The function of the bacteria in the plaque in caries must be considered as well as their interaction with the tooth substance; that is, the biochemical mechanisms by which tooth decay begins are important. Lastly, the processes ocurring in the penetration of organisms deep

*Professor of oral histology and oral pathology, College of Dentistry, University of California.

†Research associate in microbiology, section of oral pathology, College of Dentistry, University of California.

‡Bacteriologist, section of oral pathology, College of Dentistry, University of California.

§Associate professor of oral histology and oral pathology, College of Dentistry, University of California.

‖Professor of bacteriology, College of Dentistry, University of California.

1. Bagnall, J. S. Bibliography on caries research. Ottawa, Canada, National Research Council of Canada, 1950.

into the enamel need consideration. These topics will be discussed in the order listed.

ENAMEL DEVELOPMENT IN RELATION TO CARIES

The process of amelogenesis, or enamel formation, is important when the caries susceptibility or resistance of a tooth is considered. Amelogenesis[2, 3] is carried on by the ameloblast which begins to form the organic matrix of the enamel at the dentinoenamel membrane. As the matrix is laid down, it undergoes a progressive mineralization and the ameloblasts retreat outwardly until the entire thickness of enamel is complete. Although matrix development and mineralization are different processes, they are closely related.[4] The organic matrix is laid down in a definite rod pattern. The calcium and other salts are deposited between the microscopic fibers of the organic rod in a definite pattern, replacing the ostensibly fluid substance between the fibers. After completion of mineralization, the ameloblasts atrophy and no further formation of enamel is possible. Any disturbance in matrix formation or an interruption of the mineralization process will result in faulty enamel development. These defects do not repair and are retained within the body of the enamel structure. It should also be pointed out from the developmental standpoint that groups of teeth develop at different times. Since there may be a change in the environment during formation of these groups, they may have different developmental structure. This is of great importance in the later life of the tooth, since any metabolic crisis in the parent organism will affect different teeth at various stages of their development.

Narrow organic tracts in the enamel extend from the amelodentinal junction outward toward the enamel surface. In these tracts the entire organic rod may remain immature. These areas may not undergo a complete mineralization but form what are known as lamellae. These lamellae have long been related to faulty developmental patterns and are considered to be caries-susceptible areas. Thus, from the point of view of resistance or susceptibility to caries, a tooth may erupt into the oral cavity with enamel of good or bad genetic or developmental pattern.

The tooth is subjected after eruption to the manifold influences of the oral environment. These include, among other things, the deposition of bacteria on the tooth surfaces and the formation of plaques which may then interact with the various components of enamel resulting from the process of amelogenesis.

THE PLAQUE IN RELATION TO CARIES

Depending on the surface conditions of the enamel, plaques vary in thickness from visible accumulations of material to microscopic proportions which cannot be detected by instrumental examination.

A group of investigators working with the department of anatomy, University of California Medical School,[5] studied histologic sections of enamel in which plaques were retained. The plaques appeared to be amorphous and mucinous in nature and contained myriads of filamentous organisms which formed a dense mat on the tooth surface. They appeared similar to those observed earlier

2. Saunders, J. B. deC. M.; Nuckolls, J., and Frisbie, H. E. Amelogenesis: a histological study of the development, formation and calcification of the enamel in the molar tooth of the rat. J. Am. Coll. Den. 9:107 (June) 1942.

3. Nuckolls, J.; Saunders, J. B. deC. M., and Frisbie, H. E. Amelogenesis: a further study of the development of Tomes' process and the enamel rod matrix in the molar and incisor teeth of the rat. J. Am. Coll. Den. 10:241 (Dec.) 1943.

4. Nuckolls, J.; Leicester, H. M., and Dienstein, B. Amelogenesis: an integration of the known factors concerned with the development, formation and mineralization of enamel. J. Am. Coll. Den. 14:118 (Sept.) 1947.

5. Frisbie, H. E.; Nuckolls, J., and Saunders, J. B. deC. M. Distribution of the organic matrix of the enamel in the human tooth and its relation to the histopathology of caries. J. Am. Coll. Den. 11:243 (Sept.) 1944.

by Williams[6] and Black[7] and to artificial plaques produced by Ennever.[8] It was further noted that, when caries was present, the organic matrix of the enamel underlying the plaque accepted more of the histologic stain and in a slightly more advanced stage exhibited a loss of structural detail. Near the disintegrating surface coccoid forms were found. As the lesion progressed, the manner of penetration was dependent on the developmental pattern of the tooth. In the case of deeply penetrating caries, the course followed a single or multiple tract to the amelodentinal junction, where it spread back toward the tooth surface. These carious tracts were packed with coccoidal organisms.

In their observation on the histopathology of caries in the hamster, Frisbie and Nuckolls[9] found organisms in the organic cuticle which contributed to the formation of the plaque. There was a breakdown of the organic cuticle on the tooth surface following plaque formation. This preceded the extension of the lesion into the deeper enamel structures. This pathologic process resembled that found in man and was probably an enzymatic breakdown of the cuticle.

Losee and Hess[10] have demonstrated that the true organic enamel cuticle (Nasmyth's membrane) could not be removed easily from the tooth surface even by scouring. Following scrubbing and treatment with 5 per cent hydrochloric acid, they were able to tease off an organic cuticle. The teeth having deep pits and fissures had the greater amounts of total protein. The surface protein differed in amino acid content from that recovered from the body of the enamel. It is in this cuticle in human teeth that the plaque has its start.

THE ROLE OF THE PLAQUE IN CARIES

It is clear that the plaque in caries may be important in bringing about the destruction of enamel. There are two opposing views on the role of the plaque. It is supposed by one group that the plaque produces acid which dissolves enamel mineral. The other group supposes that the plaque acts primarily on the organic matrix of enamel, only secondarily liberating the mineral.[11]

Stephan[12] determined the acidity of the anterior surfaces of incisors in patients who were instructed not to brush their teeth for three to four days before the acid determinations were made. In order to develop significant acidity, it became necessary to use a glucose rinse indicating that an acidity which is capable of demineralizing enamel (if allowed to act long enough) can be developed in a "plaque." However, when the structure of a soft "plaque" (which results from the rapid accumulation of soft deposits on the teeth) is compared with the histologic organization and structure of the microscopic plaque, intimately situated on the enamel surface, there appears to be little similarity. Stephan was not convinced that acid decalcification is the single etiologic factor in caries, since he discussed several possible mechanisms for the degradation of tooth structure. Among them he suggested the removal of phosphate ions by phosphorylation and individual differences in calcium and phosphate concentrations of oral fluids which might exert

6. Williams, J. L. A contribution to the study of pathology of enamel. D. Cosmos 39:169, 269, 353, 1897.

7. Black, G. V. Discussion of J. L. Williams paper. D. Cosmos 39:403 (May) 1897.

8. Ennever, J.; Robinson, H. B. G., and Kitchin, Paul C. Studies of the bacterial plaque and dental caries. I. Method for the in vivo production of bacterial plaques suitable for microsectioning. J. D. Res. 27:599 (Oct.) 1948.

9. Frisbie, H. E., and Nuckolls, J. Histopathology of the carious lesion in the molar teeth of the Syrian hamster. (Abst.) J.D. Res. 26:470 (Dec.) 1947.

10. Losee, F. L., and Hess, W. C. Chemical nature of the proteins from human enamel. J.D. Res. 28:512 (Oct.) 1949.

11. Bodecker, C. F. Enamel proteolysis: an important factor in dental caries. New York J. Den. 18:254 (Aug.-Sept.) 1948.

12. Stephan, R. M. Intra-oral hydrogen ion concentrations associated with dental caries activity. J.D. Res. 23:257 (Aug.) 1944.

some effect on enamel solubility in different teeth. Similar concepts have been reported by Eggers Lura[13] and by Csernyei.[14]

Dietz[15] explored the possibility of producing plaques and caries *in vitro* and reported that he was unable to obtain positive results unless he reduced the saliva medium in which the teeth were incubated below pH 6. He appears to have obtained a caries-like lesion or incipient etching of 0.6 mm. depth by six weeks of incubation.

The available evidence suggests that acid produced in the plaque may play a role in caries. The extent to which acid is active has not been established, however, and there are reasons to believe that the plaque has other roles in caries besides simple acid production.

Any hypothesis that the plaque contributes otherwise to the production of enamel caries rests largely on the fact that the enamel structure contains an organic fraction. Bodecker[11,16-18] was one of the first to demonstrate that an organic matrix might be involved in the carious process. The observations of Bodecker were later substantiated by Baumgartner,[19] Fleischmann,[20] Malleson,[21] Bibby,[22] Gottlieb,[23] and more recently, by Pincus[24,25] and Atkinson and Matthews.[26] These workers postulated that caries might result, either wholly or in part, from a decomposition of the organic matrix. The work of Atkinson and Matthews[26] and Pincus[24,25] suggests that the elaboration of proteolytic enzymes by organisms of the plaque could be important in the initiation of dental caries. The study of proteolytic enzymes of the plaque is a field of research which has been almost completely ignored.

PLAQUE BACTERIA IN RELATION TO CARIES

Evidence That Plaque Bacteria Are Necessary for the Production of the Carious Lesion • The close relationship of plaque bacteria to the microscopic carious lesion indicates that they may be functional in caries production, and direct evidence is available that bacteria may be necessary for the production of the carious lesion. Blayney[27] has found that germ-free rats fed on a cariogenic diet do not develop the disease. It would seem that only when bacteria are present in the diet, does caries ensue.

Organisms of Possible Etiologic Importance in Caries • Harrison[28,29] studied the bacterial flora in experimental dental caries of rats. His preliminary studies on surface material from sound rat molars showed that almost 60 per cent of the flora consisted of streptococci of which nearly half were acidogenic. The con-

13. Eggers Lura, H. The importance of the phosphatases to caries pathogenesis. Estratti da: Rivista di Odontojatria e Ortognatodonzia 2:38 (Feb.) 1948.

14. Csernyei, J. Dental caries—a biochemical process. New York D.J. 16:241 (May) 1950.

15. Dietz, V. H. In vitro production of plaques and caries. J.D. Res. 22:423 (Dec.) 1943.

16. Bodecker, C. F. Preliminary communication upon a new method of decalcifying structures containing minute quantities of organic matter, with special reference to the enamel. D. Review 19:448, 1905.

17. Bodecker, C. F. The bacterial invasion of the enamel in dental caries. D. Cosmos 69:987 (Oct.) 1927.

18. Bodecker, C. F., and Bodecker, H. W. C. Bacterial destruction of dental enamel. J.D. Res. 9:37 (Feb.) 1929.

19. Baumgartner, E. Uber das Wesen der Zahnkaries mit besonderer Berücksichtigung der Histologie des gesunden und kariösen Zahnschmelzes. Deutsche Monatschr. f. Zahnh. 29:322, 1911.

20. Fleischmann, L. Zue Pathogenese der Zahnkaries. Ztschr. f. Stomatol. 19:153, 1921.

21. Malleson, H. C. Histology of enamel caries. Brit. D.J. 46:907 (Aug. 1) 1925.

22. Bibby, B. G. Organic structure of dental enamel as a passive defense against caries. J.D. Res. 12:99 (Feb.) 1932.

23. Gottlieb, B. Dental caries: its etiology, pathology, clinical aspects and prophylaxis. Philadelphia, Lea & Febiger, 1947.

24. Pincus, P. Production of dental caries. Brit. M.J. 2:358 (Aug. 13) 1949.

25. Pincus, P. Relation of enamel protein to dental caries. Nature 161:1014 (June 26) 1948.

26. Atkinson, H. F., and Matthews, E. Investigation into the organic components of the human tooth. Brit. D.J. 86:167 (April 1) 1949.

27. Blayney, J. R. Round table discussion. J. Am. Coll. Den. 15:155 (Dec.) 1948.

28. Harrison, R. W. Bacterial flora in experimental dental caries in the rat. Proc. Soc. Exper. Biol. & Med. 39:459 (Dec.) 1938.

29. Harrison, R. W. Bacteriological studies on experimental dental caries in rat: flora of advanced lesions. J. Infect. Dis. 67:106 (Sept.-Oct.) 1940.

clusions were that both lactobacilli and acidogenic streptococci were organisms of possible etiologic importance in caries.

Hemmens and co-workers[30] studied 44 children who, although initially free of the disease, later developed carious lesions. They studied the frequency of occurrence of 27 types of bacteria in "plaques" (accumulations on the surfaces of teeth of the subjects). Of the 27 types studied only the lactobacilli appeared to show a relative increase in frequency of occurrence with the onset of caries. The results, because of certain inadequacies, were inconclusive, however. It may be significant that filamentous bacteria (actinomycetes) were observed in all the plaques when subjected to microscopic examination.

Dietz[15] observed that a mucinous mass of filamentous organisms was present in plaques which he produced *in vitro*.

Thus far it has been established that there are oral bacteria, probable plaque components, which are able to produce acid. The principal ones which have been studied are lactobacilli,[31] streptococci,[32] and actinomycetes.[33, 34, 35]

While many oral bacteria are capable of proteolysis, little work has been done on this aspect of plaque bacteriology.

Organisms Able to Attack Enamel in Vitro • There is evidence that certain possible plaque bacteria are able to penetrate enamel in a pattern which, microscopically, simulates naturally occurring caries.

Keyes,[36] utilizing the Syrian hamster as an experimental animal, studied the effect of caries on the enamel matrix. He observed that carious lesions are associated with the accumulation of plaque material and with yellow-brown pigmentation which precedes the gross loss of the calcified structures. Coccoidal microorganisms were present in both enamel and dentin. He concluded that the fundamental process of dental caries in hamsters appears similar to that found in man.

Following the work of Keyes,[36] Frisbie and Nuckolls[9] and Nuckolls and co-workers[37] reported on a preliminary study of the character and distribution of the microscopic carious lesion in the molar teeth of the same animal. A microscopic study of the carious tracts revealed bacteria penetrating along confined channels to the dentinoenamel junction. These organisms appeared, morphologically, to be of the coccoidal type similar to those observed by Keyes in his experiments. The lesion appeared to be identical to that observed in enamel fissures and lamellae of the human teeth. The Syrian hamster is the only animal in which the degradation of the enamel matrix in caries has been identified histologically as being similar to that of man.

Hurst and co-workers[38, 39, 40] have reported on the ability of the oral bacteria to produce microscopic caries-like lesions by using the organic enamel matrix of the hamster *in vitro*. Oral actinomycetes, lactobacilli, and alpha streptococci, as

30. Hemmens, E. S., and others. Microbic flora of the dental plaque in relation to the beginning of caries J.D. Res. 25:195 (Aug.) 1946.

31. Bunting, R. W., and Palmerlee, F. Role of Bacillus acidophilus in dental caries. J.A.D.A. 12:381 (April) 1925.

32. Harrison, R. W. Lactobacilli versus streptococci in the etiology of dental caries. J.A.D.A. 37:391 (Oct.) 1948.

33. Bibby, B. G.; Van Kesteren, M., and Volker, J. F. Acid production and tooth decalcification by oral bacteria. J.D. Res. 21:61 (Feb.) 1942.

34. Hutton, W. E.; Hurst, V., and Nuckolls, J. Sugar utilization by oral actinomycetes and lactobacilli. (Abst.) J.D. Res. 28:669 (Dec.) 1949.

35. Onisi, Masao. Uber den aus der innersten Schicht des kariösen Dentins gezuchteten Aktinomyces. Stomatological Magazine, 1943, (Japan).

36. Keyes, P. H. Dental caries in the Syrian hamster. J.D. Res. 25:341 (Oct.) 1946.

37. Nuckolls, J.; Frisbie, H. E., and Killian, B. Controlled study of the character and occurrence of carious lesions in the molar teeth of the Syrian hamster under different dietary conditions. (Abst.) J.D. Res. 26:475 (Dec.) 1947.

38. Hurst, V., and others. In vitro studies of caries of the enamel in the Syrian hamster. Science 107:42 (Jan. 9) 1948.

39. Hurst, V., and others. Progress report on the bacteriologic aspect of the caries research program, College of Dentistry, University of California. J.D. Res. 28:430 (Aug.) 1949.

40. Hurst, V.; Nuckolls, J., and Frisbie, H. E. Microscopic caries-like lesions produced in vitro in the enamel of the Syrian hamster. (Abst.) J.D. Res. 28:668 (Dec.) 1949.

well as various bacteria from extraoral sources, are being tested on several hundred unerupted hamster molars. Histologic examination of approximately 280 of the hamster molars has been completed. Three distinct groups of oral organisms, the lactobacilli, alpha streptococci, and actinomycetes, have produced microscopic caries-like lesions at a neutral pH. These experiments suggest that the carious process may result from the action of more than one specific organism, and that the cariogenic properties of these bacteria may not be associated exclusively with their acidogenic properties. However, the somewhat artificial conditions of these experiments must be kept in mind.

Since it has been demonstrated that there are at least three types of oral bacteria which are able to invade hamster enamel *in vitro*, and since it has also been established that the lesion in the laboratory hamster is similar to that in man, microscopically, an evaluation of the possible roles of these three types of microorganisms seems in order.

EVALUATION OF PLAQUE BACTERIA AS CARIOGENIC AGENTS

The idea that lactobacilli are involved in the carious lesion has arisen because of the close correlation between the intake of sugars, high lactobacillus counts and caries activity. Although much of the current concept relating to the cause of dental caries is based on this premise, the actuality of the correlation is open to question. Boyd, Cheyne and Wessels,[41] studying the individual correlation of lactobacillus counts with previous and subsequent progress of caries over long periods of time, were unable to show significant correlation. Their data showed that certain children had high lactobacillus counts yet remained free of dental caries. Furthermore, there was an inconsistency of relationship between the magnitude of lactobacillus counts and the relative rate of caries progression. They concluded that the lactobacillus test could not be considered satisfactory within the group tested (60 teen-age girls) for the diagnosis of caries activity for the individual subject.

Davies,[42] in a preliminary study on the effect of 1 ppm of fluoride in the drinking water on the caries rate and the lactobacillus count, reported that there was some change in the bacterial count of the saliva when it was allowed to stand for considerable lengths of time before plating. This variation in count should be considered when evaluating the accuracy of the lactobacillus count.

Sandy and Bulate[43] point out that it was generally true that patients with rampant caries give a relatively high lactobacillus count and that caries-free patients give consistently low counts. However, an extreme variability of lactobacillus count occurs in patients who exhibit low to moderate susceptibility to caries. In the latter cases a single count can give most misleading information.

Anderson[44, 45] and Harrison[32] were not entirely satisfied with the lactobacillus-caries correlation of other workers and made intensive studies of acidogenic and aciduric oral bacteria. They gave particular attention to streptococci in the belief that all acidogenic bacteria should be considered in relation to caries. It was pointed out by Anderson[44] that gram-negative cocci and. *Leptothrix*, diphtheroid and yeast-like forms were often

41. Boyd, J. D.; Cheyne, V. D., and Wessels, K. E. Is the salivary lactobacillus count a valid index of activity of dental caries? Proc. Soc. Exper. Biol. & Med. 71:535 (Aug.) 1949.

42. Davies, E. E. Evanston dental caries study. IV. Preliminary report of lactobacillus counts in Evanston and Oak Park children. J.A.D.A. 40:37 (Jan.) 1950.

43. Sandy, C. E., and Bulate, L. Salivary lactobacillus count as an index of caries activity. Austral. J. Den. 54:18 (Feb.) 1950.

44. Anderson, T. G. Aciduric and acidogenic bacteria of the mouth in their possible relation to dental caries. Thesis for Ph.D. degree, Yale University, 1935.

45. Anderson, T. G., and Rettger, Leo F. Acidogenic and aciduric bacteria of the mouth and their possible relation to dental caries. J.D. Res. 16:489 (Dec.) 1937.

observed to be abundant in the oral cavity. The possibility that bacterial enzymes might play a role in caries was given consideration.

Although considerable emphasis has been placed on the lactobacillus group as being the probable etiologic factor in caries,[46] the idea that these organisms bear anything more than a casual relationship to the carious process is an assumption without adequate proof.

Anderson[44, 45] and Harrison[32] have considered other acidogenic and aciduric bacteria of the oral cavity, such as streptococci, as being capable of producing the necessary acid. Hemmens and others[30] reported that in "plaques" (surface accumulations on teeth) overlying caries as well as from noncarious areas, the predominating group of microorganisms that could be cultivated readily was the streptococcus. Anderson,[44, 45] Harrison[32] and others have given particular attention to the streptococci as possible cariogenic agents. From the available evidence it seems altogether possible that the streptococci could play a role in the etiology of caries but probably only under suitable conditions.

The section of oral pathology of the University of California College of Dentistry has been concerned recently with bacteriologic studies of the oral actinomycetes which are numerous in the plaque, and which may represent the majority of organisms seen in the histologic sections of the early subclinical carious lesion. These filamentous organisms cultured from plaques overlying beginning carious areas of both the human being and the hamster have been found to be highly pleomorphic.[47] Single colonies, on primary isolation, frequently contain diphtheroids, cocci and filamentous cells. Serial observations of growing single cells have shown that coccoid forms may give rise to filaments implying that the reverse also may occur. The factors influencing the transformation from one cell phase to another are not known. However, the ability of oral actinomycetes to exist in an entirely nonfilamentous phase makes their identification, as well as that of other oral flora, extremely difficult. It further suggests that the coccoidal organisms seen within carious enamel may be the progeny of the filamentous organisms of the surface plaque.

Studies also have been conducted to compare pure cultures of certain strains of actinomycetes and lactobacilli in their utilization of certain sugars.[34, 48] These organisms are known to have produced caries-like lesions in the molars of Syrian hamsters in the *in vitro* studies. Of seven strains of actinomycetes and of three strains of lactobacilli, all fermented glucose, maltose and sucrose. Only two strains each of the lactobacilli and actinomycetes fermented lactose. After 30 hours of incubation at an initial pH range from 7.6 to 7.8, six of the seven actinomycete strains produced a heavier growth in glucose peptone broth than in peptone broth. In seven days all seven actinomycete strains produced considerably more acid from sucrose than did the three lactobacillus strains. The terminal pH range for the actinomycetes was 5.0 to 5.8, while the terminal pH range for the lactobacilli was 6.5 to 7.6. The initial pH was 7.8. For purposes of clarification it must be pointed out that only those strains which produced caries *in vitro* were examined. It must be noted that the high initial pH was not maintained in all of the lactobacillus cultures and in spite of this the actinomycetes, in the relatively long incubation period, still produced more acid from sucrose than did the lactobacilli.

46. Becks, H.; Jensen, A. L., and Millarr, C. B. Rampant dental caries: prevention and prognosis. J.A.D.A. 31:1189 (Sept. 1) 1944.

47. Hurst, V. Morphologic instability of actinomycetes associated with enamel. J.D. Res. 29:571 (Oct.) 1950.

48. Hutton, W. E.; Hurst, V., and Nuckolls, J. Sugar utilization by oral actinomycetes and lactobacilli. J. Am. Coll. Den. 17:99 (June) 1950.

The data show that under certain conditions the actinomycetes tested were able to produce more acid from sucrose and a heavier growth from glucose than the lactobacilli. These findings indicate that the actinomycetes of the dental plaque may be important in acid production on the surfaces of teeth. If this observation can be applied to the changes which have been observed on the tooth surface, it may partially explain the initial breakdown of the enamel surface for the entrance of invading organisms.

While the lactobacilli and streptococci have been recognized as organisms capable of producing acid of sufficient strength to decalcify enamel, it should now be recognized that the actinomycetes also are capable of producing the necessary amounts of acid. Histologic demonstrations of the morphological character of the plaque indicate that actinomycetes may be closely associated with the enamel surface. There seems to be some relation between bacteriologic and biochemical studies and the histologic observation that the organisms which penetrate into the deeper structures of the enamel may be morphological variants of the surface actinomycetes.

POSSIBLE BIOCHEMICAL MECHANISMS ACTIVE IN INITIATING CARIES

That acid produced by bacteria from environmental carbohydrate can demineralize enamel has been known for a long time, and the belief is popular that this is the important biochemical mechanism of caries. As pointed out by Shaw,[49] however, this idea probably is an oversimplification. In a series of nutritional studies it was observed that, unless fed during the period of tooth development, a balanced diet containing high proportions of sucrose did not contribute significantly to caries susceptibility of rats. To the extent that it is permissible to generalize on these results, it would seem that there is an intrinsic susceptibility of teeth to decay which may be more influenced by pre-eruptive diets than by subsequent nutritional events. These results have been confirmed by others, for example, McClure.[50]

In a preliminary investigation of the influence on the composition of rat incisors of feeding a balanced high-sucrose diet during tooth formation, Hartles[51] found that such a diet resulted in the formation of enamel and dentin with higher contents of both calcium and phosphorus than is normal. Although Hartles appears to believe that increased calcification would make it more likely for a tooth to undergo acid demineralization, it seems unlikely that such a condition would increase the rate of progress of caries, especially if it is an acid decalcification.

On the contrary, it would seem that the rate of penetration by acid decalcification would be retarded in more completely mineralized tissues on quantitative grounds alone. Thus Hartles' results appear to be in contradiction to the idea that caries is an acid decalcification. These observations are, however, as yet only preliminary. Calcium and phosphate are major constituents of hard dental tissues, but carbonate and other substances, especially the organic substances, may play a role in determining tooth susceptibility. It is possible that the organic substances of enamel may serve as substrates for acid production. These possible sources of acid also should be considered since they may be used to set up alternative hypotheses.

Atkinson and Matthews,[26] who applied paper partition chromatography to a qualitative analysis of proteins from

49. Shaw, J. H. Modern concept of the etiology of dental caries—the acidogenic theory. Internat. D.J. 1:48 (Dec.) 1950.

50. McClure, F. J. Experimental dental caries in rats. J. Nutrit. 43:303 (Feb.) 1951.

51. Hartles, R. L. The effect of a high-sucrose diet on the calcium and phosphorus content of the enamel and dentin of rat incisors. Biochem. J. 48:245 (Feb.) 1951.

carious and noncarious dentin, found 18 amino acids in sound dentin matrix. With the exception of a reduction in amount of certain ones, a similar series of acids was found in carious dentin matrix. Most important of these were glutamic and aspartic acids which, although absent from the matrix protein, were present in the carious dentin as the free acids. Both glutamic and aspartic acids are relatively strong and capable of demineralizing enamel and dentin. In other words, proteolysis can give rise to acid decalcification.

Pincus[24, 25] advances an explanation for the caries mechanism which is essentially similar to the hypothesis of Frisbie[6, 52] and of Atkinson and Matthews.[26] However, the chemical reactions differ in that Pincus[24, 25] contends that an enzyme, sulfatase, can release sulfuric acid from a mucoprotein fraction of the enamel, thus producing a demineralization of the hard structure.

It is possible that acid can be produced from the carbohydrate containing substances of the enamel. Engel[53] has demonstrated the presence of an acid-soluble substance in enamel which gives some of the reactions of a carbohydrate. Engel believes this substance to be a glycoprotein complex. Sognnaes and Wislocki[54] reported the presence of a sugar-containing substance (acid mucopolysaccharide) in both enamel and dentin. To what extent acid produced from carbohydrate contained in the enamel can be functional in the caries process remains to be established.

Although decalcification of the enamel usually is attributed to the action of acid, other mechanisms by which it may occur must also be given consideration. As mentioned previously, demineralization may be brought about by phosphorylation.[12, 13] It has also been proposed that citrate ion may decalcify the enamel.[12] McClure and Ruzicka[55] were able to obtain decalcification of rat enamel with citrate ion and concluded that nonacid decalcification of this type may play a role in caries. Further suggestion that mechanisms other than acid decalcification may be involved in caries is found in the work of Schlack and co-workers.[56] They observed that while oxalates protected rat molars against the action of acid beverages, the oxalates did not protect the animals against caries.

In discussing the factors other than acid which play a role in enamel caries, consideration must be given to the organic component of enamel and its associated structures. The early histologic observations of Bodecker[16-18, 11] and those of later investigators[19-24, 57, 28, 10] have demonstrated that the enamel contains an organic fraction. This is a long step forward from the prevailing hypothesis of Williams[6] that enamel was entirely inorganic. Although Miller[58] considered that enamel contains "but 2 to 5 per cent of organic sustance" he stated:

> . . . dental decay is a chemico-parasitical process consisting of two distinctly marked stages: decalcification, or softening of the tissue, and dissolution of the softened residue. In the case of enamel, however, the second stage is probably wanting, the decalcification of the enamel practically signifying its total destruction.

At the time (1890) there was no reliable histologic or chemical evidence of the distribution of the organic component of the enamel, its composition, or its

52. Frisbie, H. E., and Nuckolls, J. Caries of the enamel. J.D. Res. 26:181 (June) 1947.

53. Engel, M. B. Glycogen and carbohydrate-protein complex in developing teeth of the rat. J.D. Res. 27:681 (Dec.) 1948.

54. Sognnaes, R., and Wislocki, G. B. Jelly chemical may be destroyed in tooth decay. Science News Letter 57:8 (Jan. 7) 1950.

55. McClure, F. J., and Ruzicka, S. J. The destructive effect of citrate vs. lactate ions on rats' molar teeth surfaces in vivo. J.D. Res. 25:1 (Feb.) 1946.

56. Schlack, C. A., and others. The role of oxalates in rat dental caries. J.D. Res. 26:383 (Oct.) 1947.

57. Sognnaes, R. F. Organic elements of the enamel. I. A study of the principal factors involved in the histological preservation of the organic elements of enamel and other highly calcified structures. J.D. Res. 27:609 (Oct.) 1948.

58. Miller, W. D. Microorganisms of the human mouth. Philadelphia, S. S. White Dental Mfg. Co., 1890.

relationship to the caries process. Such considerations on Miller's part at that time must have been largely speculation. Thus the inorganic concept formed the basis of Miller's acid-decalcification theory of enamel caries.

While it is true that the dry organic matter of enamel is probably less than 1 per cent of the total enamel,[10] yet this organic matter plus attendant moisture can be estimated to occupy more than 12 per cent of the enamel by volume as pointed out by Bodecker.[11] It may be objected that because of the small relative weight of the organic content of enamel, it is unimportant. But if one considers that in lamellae and in the organic cuticle there is an additional concentration of organic matter, this view appears naive.

Bodecker[17, 18] observed organisms within the organic matrix but the histologic technics of that period were not sufficiently advanced to present a clear picture. These early researches have been recently confirmed by Frisbie and co-workers.[5, 52] These investigators have been able to remove completely all inorganic matter from the organic part and to study the histopathologic changes which occurred in the carious lesion. The organic matrix of an apparently hard enamel surface underneath a plaque shows a degenerative change and a loss of structural detail. The surface appearance of such a lesion might be a whitened or yellow-stained area. A matrix change in the microscopic lesion beyond the site of organisms indicates that this reaction is probably enzymatic in nature, since no organisms are present in the matrix, the enzyme being liberated from the organisms in the plaque.

The yellow-brown pigment often seen in the early lesion could result from the breakdown of the organic matrix of enamel. The oxidation of tyrosine or tryptophane, amino acid components of enamel and dentin, to form melanin, is one mechanism which Deakins[59] has suggested. Dreizen and co-workers[60] speculate that the pigmentation is not melanin but may be the result of action of some of the intermediate products of carbohydrate fermentation on the organic matrix. These suggestions, if substantiated, would tend to show that an early degenerative change, in which proteolysis, or perhaps a carbohydrate fermentation, may play a part, has taken place in the enamel directly beneath the microscopic plaque. Evidence that the enamel organic matter is destroyed early in the carious process is found in the work of Keil.[61] He found that when enamel was decalcified by acids, the negative birefringence of the tooth fell to isotropy and then became positive. This change in double refraction implies the formation of open spaces in the enamel. In addition, the decalcified enamel imbibes liquids. In contrast, enamel which has had the organic matter removed by chemical agents is positively birefringent but does not imbibe liquids. In carious enamel negative birefringence is lost and liquids are not imbibed, indicating that carious enamel resembles more closely that in which the organic matter has been destroyed.

McKenzie[62] has demonstrated the possibility of disruption of enamel by mechanical stresses when its organic matrix is dissolved in concentrated sodium hydroxide. The enamel mineral is insoluble in sodium hydroxide. While these conditions are not physiologic, the experiment demonstrates the possibility of a mechanical breakdown of the enamel when the organic matrix is destroyed.

59. Deakins, M. L. The isolation of a melanin-like substance from carious organic matrix of human dentin. J.D. Res. 20:39 (Feb.) 1941.

60. Dreizen, Samuel, and others. In vitro production of a "yellow-brown melanin-like pigment" in the organic matrix of noncarious human tooth crowns by methylglyoxal (pyruvic aldehyde) and acetol (acetyl carbinol). J.D. Res. 28:26 (Feb.) 1949.

61. Leicester, H. M. Biochemistry of teeth. St. Louis, C. V. Mosby Co., 1949.

62. Mackenzie, J. Significance of the living organic tissue of the teeth in dental caries. New Zealand D.J. 41:84 (July) 1945.

To the extent that the mechanisms of enamel and dentin caries are similar, the hypothesis that mechanisms other than acid decalcification are involved in the process receives some support from the studies of Manly and Deakins.[63] In biochemical studies of carious dentin, they found that the zones of earliest decay exhibit little loss of inorganic material but considerable loss of organic material. The major loss of inorganic material occurred in the outer and most advanced zones of decay.

Hugill[64] recently reported on the experimental production of artificial dental caries by proteolytic enzymes. He attempted to produce a disintegration of enamel by several means. First he employed enzymes in an attempt to digest the organic fraction of the enamel. Secondly, organic acids were used independently of the enzymes. Neither the enzymes nor the organic acids alone produced caries-like lesions. However, an admixture of acid and enzymes produced a lesion which could be demonstrated in ground sections which closely resembled the deeply penetrating pathologic lesion in human enamel. Evans and Prophet[65] found that dentin could be dissolved by citrates and bacterial enzymes acting together. If these observations can be substantiated, they will be of great significance in that they may demonstrate both enzymes and acids to be necessary factors in the production of enamel caries.

The evidence seems good that the decomposition of the organic portion of the enamel plays an important role in caries. It is impossible at the present level of knowledge to select the principal mechanisms by which the mineral and organic fractions of the enamel are destroyed. All of the ones mentioned earlier are possible and could play a role, but how much of a role must remain unknown until a considerably greater amount of investigation has been carried out.

INVASION OF DEEPER STRUCTURES OF ENAMEL BY CARIES

In their studies of the organic matrix in erupted teeth, Frisbie and co-workers[5] have shown the presence of organisms deep within the enamel. Several distinct types of invasion have been described in the carious process. Briefly, one type of lesion extends from the surface along well defined channels to the amelodentinal junction and establishes a focus on the enamel side of the junction. Another spreads through the enamel and follows an irregular pattern. The channels where the organisms have penetrated show a disintegration of the matrix, although generally the surrounding enamel seems intact. The tracts, which are present possibly because of faulty development, are filled with coccoidal organisms.

Keyes[36] and, later, Frisbie and Nuckolls[9] have observed similar lesions which occurred spontaneously in the molar teeth of living hamsters. As in human caries, coccoidal organisms are seen within the enamel. The presence of coccoidal organisms deep within the enamel has led to some controversy as to what they are, how they got there, and by what pathologic process do they bring about the disintegration of the enamel.

As previously mentioned, Hurst's[47] studies of actinomycetes isolated from the plaque show them to be highly pleomorphic. These observations led to a study of caries in the test tube in which unerupted hamster molars were infected

63. Manly, R. S., and Deakins, M. L. Changes in the volume per cent of moisture, organic and inorganic material in dental caries. J.D. Res. 19:165 (April) 1940.

64. Hugill, R. A., and Box, H. K. Experimental production of artificial dental caries. Presented at the International Association of Dental Research Meeting, French Lick Springs, Ind., March, 1950. (Abst.) J.D. Res. 29:669 (Oct.) 1950.

65. Evans, D. G., and Prophet, A. S. Enzymes of Clostridium welchii Type A and Clostridium histolyticum that disintegrate decalcified human tooth dentine. J. Gen. Microb. 4:360 (Sept.) 1950.

with pure cultures of the actinomycetes. In the *in vitro* studies[38, 39, 40] the organisms penetrated from the enamel surface down the prisms. These organisms sometimes appeared as cocci. This observation again leads to the speculation that the coccoidal organisms seen in human and hamster caries may be coccoidal variants of the filamentous types seen in the surface plaque.

It is possible to envision a nutrient source for the organisms in the surface plaque as well as a mechanism for the initiation of the lesion. However, when the density of the enamel is considered, a nutrient source for the organisms within the hard enamel seems, at first thought, almost an impossibility, although serial histologic sections show organisms to be present and in great numbers.[5, 52] The lateral extension of the lesion along the enamel side of the dentinoenamel junction is difficult to explain if one assumes that the enamel is not a source of nutrients.

The researches of Engel[53, 66] and Sognnaes[54] show that the organic portion of the enamel contains an acid-soluble carbohydrate fraction, which is a possible nutrient source. Investigations of this nature indicate that more nutrient sources may be available within the enamel than have heretofore been appreciated.

Investigations which utilize the method of chromatography in determining the amino acid content of enamel and dentin[26] also throw some light on the process. As mentioned previously, this method shows that free organic acids are present in carious dentin. The investigators who first applied this method in analyzing the protein content of tooth structure suggested that an enzyme of an organism associated with the carious process brought about the breakdown of the protein of the matrix. Since some of the amino acid products of this reaction are glutamic and aspartic acids, these in turn could demineralize the enamel and free more matrix for enzymatic degradation. A somewhat similar mechanism[24, 25] which has been suggested for the degradation of the matrix is the action of the enzyme sulfatase on the mucoitin sulfate of the matrix. The sulfuric acid thus produced could also free more matrix for degradation. By such mechanisms the carious process could extend along the carious tracts and deep within the enamel structure as well as on the enamel surface. They may account for the extension of the carious lesion at the dentinoenamel junction.[5, 52] An explanation of this kind more nearly coincides with the histologic, bacteriologic and biochemical observations of the California group than any other put forth to date.

SUMMARY

Caries is a complex disease process which may not have a specific etiology. Only by understanding principles underlying the disease, can the confusion attendant upon its complexities be avoided. Certain principles have not been sufficiently emphasized in the past. Hence a re-examination of the factors involved may lead to a better understanding of the disease and, ultimately, to more sound methods for its prevention and control.

The development of enamel is one such factor to which too little attention has been paid.

It is possible that variations in the organic content of the enamel determine, in part, differences in caries susceptibility. Such variations in the distribution of both the organic and inorganic fractions of enamel must be attributed to individual differences in the development of that tissue. The evidence establishing the importance of enamel matrix in the carious process is difficult to ignore. It has been demonstrated that acid decalci-

66. Engel, M. B. The softening and solution of the dentin in caries. J.A.D.A. 40:284 (March) 1950.

fication is not identical with caries. Studies on the birefringence of enamel indicate that caries most nearly resembles a process in which there is initially a preferential loss of organic matter. Studies on dentin caries, which must resemble enamel caries in certain respects, indicate a preferential, initial loss of organic matter in the development of the lesion. Available histologic and bacteriologic data indicate that the organic enamel matrix may supply, in part, nutrients utilized by bacteria in the initial phases of the disease. Therefore, the degradation of enamel matrix plays an important part in caries.

The enamel structure alone, however, probably is not the sole determinant of caries susceptibility. The cariogenic potential of the plaque also must be considered. At the present time there seem to be two schools of thought concerning plaque function. The first school maintains that the sole function of the plaque in caries is to bring about an acid decalcification of enamel by fermenting the carbohydrates often present in the oral environment. The second school insists that proteolysis of the organic matrix of the enamel is most important. Recent work appears to indicate that simultaneous decalcification and degradation of enamel matrix are essential to the development of caries. This idea seems to fit in better with what is known of microorganisms than either extreme position. The concept that the plaque acts as an ecological unit rather than as isolated individual strains of microorganisms must be entertained.

It has not been established that certain specific bacteria are the causative agents of dental caries. Both acidogenic and nonacidogenic organisms are associated with the carious process. Among the various oral organisms which have been thought to be concerned with dental caries are the lactobacilli, the streptococci, the actinomycetes of the plaque, actinomycetes of the deep lesion, the postulated organisms of Atkinson and Matthews, and the sulfatase-producing bacteria of Pincus.

That the foregoing concept of caries is incomplete in many respects, and perhaps erroneous in some, is understood. The data of caries research are also incomplete in many respects and perhaps erroneous in others. If any of the suggestions or ideas presented in this paper have a stimulative action on caries research or act to broaden the concepts of those interested in the field, the discussion will have served its purpose.

Values • Abundance, even of good things, prevents them from being valued; and scarcity, even in the case of what is bad, confers a certain value. ***Don Quixote, Preface, Part II.***

An investigation of the chemistry of dental amalgam by roentgen ray diffraction

Clarence B. Frankel, D.D.S., and I. Fankuchen, Ph.D., Brooklyn*

Roentgen rays have become such an important and integral part of dental practice today that one cannot even comprehend modern dental practice without the everyday use of x-ray diagnostic equipment.

Just as they have become so important in the practice of dentistry, roentgen rays are and will become more important in dental research.

To illustrate the ease and value of roentgen ray diffraction in dental research, a simple experiment investigating the mechanism of the setting of amalgam was undertaken. This topic was chosen primarily because it was little understood and secondarily because specimen material was readily available.

Roentgen rays have been used previously in limited scope in dental studies both in this country and abroad.

The early studies were done at the University of Rochester School of Medicine and Dentistry, and the results were published in the United States[1,2] and Germany.[3,4] Using roentgen ray diffraction technics this group found that adult and fetal teeth were composed essentially of mineral constituents similar to the naturally occurring mineral apatite, and that no calcium carbonate was present. They also used roentgen rays to study the orientation of the inorganic crystals in enamel, and determined the crystal particle to be extremely small, in the nature of 10^{-6} cm.

In 1946, Beevers and McIntyre,[5] using roentgen ray diffraction technics exclusively, worked out in detail the atomic structure of fluorapatite and showed that roentgen ray analysis definitely established that if an OH group or CO_3 group or both are substituted for F in the mineral fluorapatite, the structure of the inorganic crystals of enamel and dentin results.

Other studies published in France,[6,7] England,[8] and the United States[9,10] all tended to verify the earlier discovery of

From the division of applied physics, Polytechnic Institute of Brooklyn, Brooklyn.

*Professor of applied physics and head of the division of applied physics, Polytechnic Institute of Brooklyn, Brooklyn.

1. LeFevre, M. L.; Bale, W. F., and Hodge, H. C. The chemical nature of inorganic portion of fetal tooth substance. J. D. Res. 16:85 (April) 1937.

2. Bale, W. F.; Hodge, H. C., and Warren, S. L. Roentgen-ray diffraction studies of enamel and dentine. Am. J. Roentgenol. 32:369 (Sept.) 1934.

3. Bale, W. F., and Hodge, H. C. Über die Kristallorientierung in Zahnschmelz. Naturwiss. 24:141, 1936.

4. Bale, W. F.; LeFevre, M. L., and Hodge, H. C. Über den Anorganischen der Zahn. Naturwiss. 24:636, 1936.

5. Beevers, C. A., and McIntyre, D. B. The atomic structure of fluorapatite and its relation to that of tooth and bone material. Minerological Magazine, London 27:254 (Sept.) 1946.

6. Dallemagne, M. J.; Brasseur, H., and Melon, J. La constitution de la substance minerale de l'os et la synthèse des apatites. Bul. de la Soc. Chimique de France, 1er Trimestre, no. 2234, p. D109, 1949.

7. Dallemagne, M. J., and Melon, J. La localization d l'apatite et du phosphate tricalcique dans l'email dentaire. Extrait des Archives de Biologie 57:79, 1946.

the mineral nature of the inorganic constituents of teeth and bone.

Gerould[11] showed that CaF_2 forms when enamel is immersed in sodium fluoride solutions.

More recently, Sobel and Fankuchen[12,13] used roentgen ray diffraction methods to study changes in the composition of teeth induced by diet and fluoride treatment.

Special mention should be made of the work by Thewlis,[14] who made a detailed roentgenographic study of the composition, crystallite size, orientation of the crystallites and the degree of calcification, both qualitatively and quantitatively, of different areas of normal human dental enamel and dentin. His classic and monumental report of seven years of work on roentgenographic studies of teeth should be studied by all interested either in the structure of the teeth or the application of roentgen rays for dental research.

With the exception of work now being done by a group headed by E. Kline at New York University, School of Dentistry, using roentgen ray microcamera technics[15] to study the orientation of the apatite crystals in enamel and dentin and the effects of the carious process, practically all studies were made by physicists, chemists and geologists without dental research personnel; and on the whole, this excellent tool for the research worker has been shamefully neglected in dental research. Because of the almost complete lack of knowledge and understanding in dental circles regarding roentgen ray diffraction, this paper will deal more with certain fundamentals of roentgen ray diffraction work than with the experimental results themselves, important and interesting as they were.

FUNDAMENTALS OF ROENTGEN RAY DIFFRACTION

Roentgen ray diffraction is used essentially to provide information about atomic arrangement, the way atoms are placed about other atoms, the interatomic distances and the stereochemical configuration of groups of atoms. One of the principal reasons roentgen rays are so useful is that they make possible the use of d measuring unit—the wave length of the roentgen rays—which is approximately the same order of magnitude as the dimensions of the atoms themselves, thus permitting convenient experimentation.

In practice, roentgen ray diffraction experiments are all similar. One impinges an essentially parallel monochromatic beam of roentgen rays on a specimen. Most of the rays pass through the specimen, and it is these rays that give the familiar roentgenogram from which a diagnosis is made in medical and dental roentgenology. In roentgen ray diffraction, however, the undeviated transmitted radiation is allowed to pass through a hole in the film or is absorbed by a lead stop. Only the scattered radiation which makes some kind of pattern on a photographic plate is of interest here. This record of scattered radiation is the raw material used in roentgen ray diffraction.

A variety of technics may be used in gathering information. It is possible to take a roentgen ray diagram of a single crystal, either stationary, rotating, or

8. Brasseur, H.; Dallemagne, M. J., and Melon, J. Chemical nature of salts from bone and teeth and tricalcium phosphate precipitate. Nature 157:453 (April 6) 1946.

9. Hirschman, A., and others. X-ray diffraction study of high phosphate bones. J. Biol. Chem. 171:285 (Nov.) 1947.

10. Reed, B. P., and Reed, C. I. X-ray diffraction studies on human dental enamel. Fed. Pro. 6:185, 1947.

11. Gerould, C. H. Electron microscope studies of the mechanism of fluorine deposition in teeth. J. D. Res. 24:223 (Oct.) 1945.

12. Sobel, A. E., and others. Calcification of teeth. J. D. Res. 28:61 (Feb.) 1949.

13. Sobel, A. E., and others. Calcification of teeth. J. Biol. Chem. 179:205 (May) 1949.

14. Thewlis, J. The structure of the teeth as shown by x-ray examination. Special Report Series 238, Medical Research Council. London, His Majesty's Stationery Office, 1940.

15. Klein, E., and others. An x-ray diffraction microcamera and the specimen preparation for the study of tooth structure. J. D. Res. 30:439 (June) 1951.

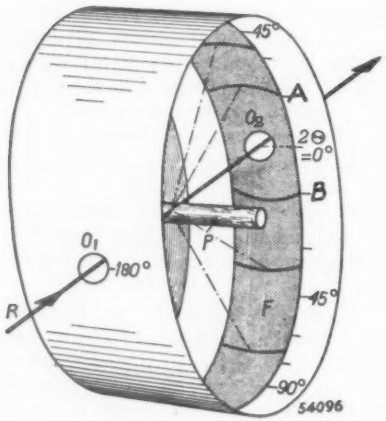


Fig. 1 • Principle of the Debye-Scherrer camera—monochromatic beam, R, enters the cylindrical camera through aperture, O_1, and is partly diffracted in specimen, P. Cones of diffracted rays emerge which intersect the film, F, and produces lines (arcs or rings) on film. The undiffracted part of the beam leaves camera through aperture, O_2. (Courtesy of W. Parrish and North American Philips Co.)

oscillating, and with film either stationary or oscillating, or a diagram of a powdered specimen or a chunk of material. Cylindrical cameras, flat-plate cameras, microcameras, or any one of several other types may be used.

The results with each are essentially similar—a pattern from the scattered radiation. This pattern is analyzed as to position of the scattered rays and their intensities. The analysis does not have to be brought to completion in order to obtain useful information. At every step of the analysis information of a different character is obtained. Depending on the information desired, a partial or more complete analysis can be made.

When a beam of x-ray radiation passes through a polycrystalline specimen which may be a powdered crystalline solid, cones of diffracted beams emerge from the specimen. If a photographic film is placed behind or around the specimen, a record will be obtained of the cones intersecting the surface of the film (Fig 1). Simple examination of the films in Figure 2 shows many arcs of varying intensities appearing in certain positions of the films.

Most of the familiar solid substances—wood, rocks, soil, sand, chemicals, pigments, tooth powders, steel, concrete, bones and teeth—consist of small crystals. They are crystalline because the atoms or molecules of which they are composed are packed together in a regular manner, forming a periodic three dimensional pattern.

It is this orderly arrangement of molecules and atoms composing solid substances that makes it possible to determine precisely the molecular structure, and also provides powerful and certain methods of identification and analysis, using roentgen rays.

Since most solids are crystalline—that is, they are composed of atoms arranged in an orderly fashion—it is possible to imagine them as divided into many planes or layers of atoms (Fig. 3). This is important, since the reflected roentgen ray beams are reflected by such planes of atoms, or, more exactly, by the electron shells surrounding the atoms in these planes. It is this internal geometry of the solid substance that determines the position of each reflection on the film.

Solid crystalline substances can also be geometrically broken down to what is known as the unit cell, the smallest basic pattern of atoms which is repeated regularly in three dimensions, just as the pattern of a wallpaper is repeated over and over in two dimensions. The position of the atoms in the unit cell and the kind of atoms are the chief determining factors influencing the intensities of the reflections.

SOURCE OF ROENTGEN RAYS

For the roentgen ray diffraction studies on amalgams we used a monochromatic

beam of roentgen rays with a wave length of about 1.54 angstrom units. This beam is obtained by using a copper target in the x-ray tube with an accelerating voltage of 35,000 volts and an anode current of 15 milliamperes. The roentgen rays produced thereby are filtered with a nickel filter approximately 0.02 mm. thick, and by passing the filtered ray through a slit system, parallel rays emerge. By varying the target material within the x-ray tube and the filter material, it is possible to obtain monochromatic beams of 0.70, 1.54, 1.65, 1.78, 1.93 and 2.28 A.U., and others. Incidentally, monochromatic, referring to roentgen rays, has the same meaning as when referred to color or light waves—essentially, one wave length or a narrow slice of the spectrum.

For comparison, dental x-ray machines produce a polychromatic radiation or continuous band of wave lengths (known as white radiation) limited on the short wave length side by the accelerating voltage, and in the dental machine (60,000 volts) will be about .205 A.U. and extending to about 2 A.U. on the

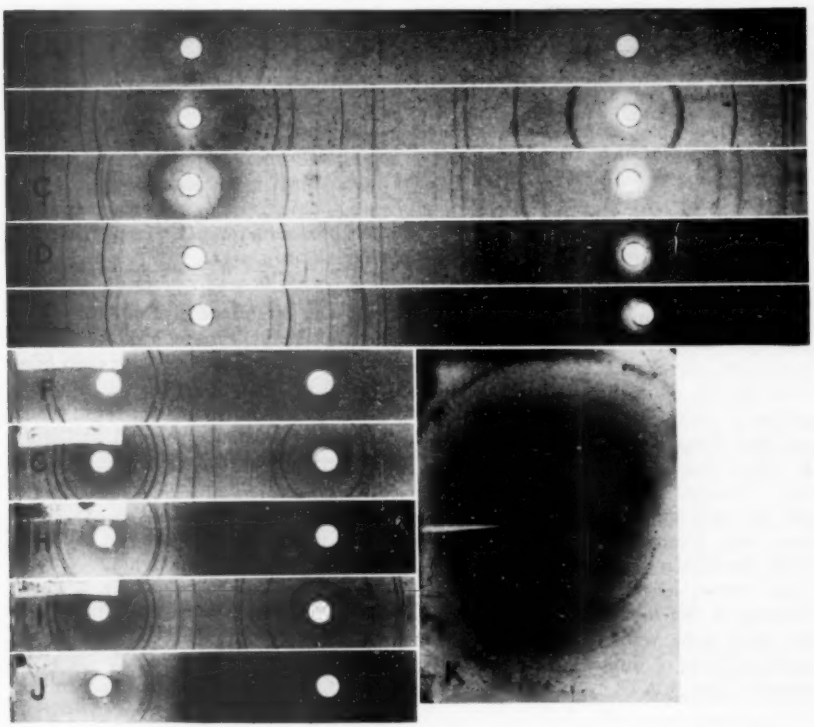


Fig. 2 • Some of the roentgenograms obtained in studying amalgams. (a) Pure tin; (b) pure silver; (c) amalgam alloy; (d) silver amalgam Ag_2Hg_3; (e) amalgamated alloy (filling); (f) "pure" copper dust; (g) burnt-out copper electro deposits; (h) amalgamated copper; (i) "mixed" metals; (j) mixed metals amalgam; (k) flat plate diagram—"water" amalgam

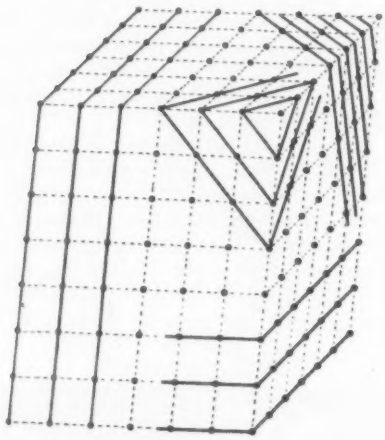


Fig. 3 • Illustrating a few of the simpler methods of dividing a crystalline solid into planes. Many more possibilities for division exist. (After Bunn)

long wave side. In addition to this continuous band and superimposed on it are narrow peaks of great intensities, the wave lengths of which are rigidly determined by the nature of the target material (the higher the atomic number of the target, the shorter the wave length). This sharply defined radiation is known as the K series and the strongest peaks are the $K\alpha_1$, $K\alpha_2$ (K alpha one and K alpha two) and K_β (K beta). In our roentgen ray diffraction studies the K_β and most of the white radiation was filtered off to give essentially the Cu$K\alpha$ (copper K alpha) radiation (wave length 1.54 A.U.). Some filtering of the dental roentgen rays by the thick tube walls does result in removal of most of the soft or longer wave lengths above 1 A.U.

ANALYSIS OF ROENTGEN RAY DATA

When a parallel monochromatic beam of radiation strikes an atomic plane, there is a tendency for reflection similar to that when light hits a mirror; that is, the angle of reflection equals the angle of incidence with the reflections occurring over a wide range of incidence angles. However, when the beam strikes any crystalline substance with its many different sets of parallel planes of atoms, there are only a few angles of incidence at which any given set of parallel planes can reflect. These are called the Bragg angles Θ (theta), and are determined by the wave length of the roentgen ray beam and by the distance between successive parallel planes, the interatomic space, the relationship being:

$$\frac{d}{n} = \frac{\lambda}{2\sin\Theta}$$

where lambda (λ) = wave length in A.U. of roentgen ray beam
d = distance of A.U. between successive parallel identical atomic planes of the solid
theta (Θ) = the angle between the roentgen ray beam and these atomic planes
n = any whole number.

At any angles other than the Bragg angles, the reflections from successive identical planes interfere with each other and no reflected ray comes out. But at one angle and only one for a set of planes with an interplanar spacing, d, and order, n, the reflections from each plane actually reinforce each other because their waves are in phase and reflection occurs. Each arc on the film in Figure 2 is a reflection from a group of parallel planes having a definite characteristic spacing, d. Parallel planes whose interplanar spacing is another value of d reflect at another angle of incidence and produce their arc in another position on the film. In taking a powder diagram in a cylindrical camera, steps are taken to make sure there is absolute random orientation of crystals so that all possible crystal planes will be presented to the roentgen rays at their respective Bragg angles Θ.

Various factors, one of the most important being the exact nature and arrangement of the atoms in the unit cell, influence the intensity of each reflection in the roentgen ray diagrams in Figure 2. It is important to know that each crystalline substance produces its own unique diffraction pattern characterized by the spacings of its lines and their relative intensities. Mixtures of crystalline substances yield patterns which are sums of the individual patterns. Roentgen ray diffraction diagrams can therefore be used to identify crystalline materials.

One procedure, the indirect method of identification, involves the comparison of the pattern of the unknown with the pattern of a likely, known substance. This method is useful in some instances but obviously cannot be used as a general means of identification. Much more useful is the direct method of identification in which reference is made to an index based upon the classification, in convenient form, of the patterns of the more common chemical substances. Tables and card catalogues of this sort are readily available. One of the most commonly used is the card index published by the joint committee of the American Society for X-Ray and Electron Diffraction and the American Society for Testing Materials (A.S.-T.M. card index). The cards list the interplanar distances, d, the relative intensities of the reflections, the dimensions of the unit cell and crystal classification of some 4,500 substances. One card is listed for each substance; the three strongest lines of the pattern are listed in order of decreasing intensity on each card and the cards are arranged in order of decreasing spacings of these three strongest lines. In addition, the spacings and relative intensities of all the lines of the spectrum are listed on cards indexed under the strongest line.

It is a relatively simple matter to compute mathematically the d spaces of the planes giving rise to each reflection together with a visual estimate of the relative intensities and then from the card index system to find the substance giving these values.

From the distance between the same arcs on either side of the central-beam entry or exit holes (that is, the diameter of the cone of reflection as it intersects the film, distance A-B, Figure 1) plus the radius of the camera used (the distance from specimen to film, P-O_2, Figure 1), the angle Θ can be computed. From angle Θ and the wave length of the radiation, $\frac{d}{n}$ is computed as per the Bragg formula given previously.

In our experiments we used almost exclusively Debye-Scherrer cameras[16] (Fig. 4). The diameters of these cameras are either 57.3 or 114.6 mm. These seemingly odd diameter values have the advantage that the diffraction angles, 2 Θ, are in a simple way numerically related to the line distances measured in millimeters on the film; that is, 1° of 2 Θ corresponds to 1 mm. with the larger camera and the 0.5 mm. with the smaller camera. This eliminates the necessity for mathematical computations of angle Θ.

The mathematical computations of d spaces from angle Θ, in accordance with the Bragg angle formula, can also be eliminated by the use of conversion charts which are readily available.

In some cases a ruler, calibrated in d space values may be used to determine interplanar spacings directly from the film.

All these procedures were followed in the experiments outlined in this article.

EXPERIMENTAL STUDIES

In carrying out our investigation, the following roentgen ray diagrams were taken in either Debye-Scherrer cylindrical cameras or with flat-plate cameras.

16. Parrish, W., and Cisney, E. An improved x-ray diffraction camera. Phil. Tech. Rev. 10:157 (Dec.) 1948.

1. "Pure" copper.
2. Pure silver.
3. Pure zinc.
4. Pure tin.
5. Mercury.
6. Mixture of Cu, Ag, Zn and Sn in proportions usually found in alloy.
7. Alloy of Cu, Ag, Zn and Sn (commercial amalgam alloy).
8. Amalgamated and set alloy.
9. Amalgamated and set silver.
10. Amalgamated copper.
11. Amalgamated tin.
12. Amalgamated zinc.
13. Amalgam containing excess mercury.
14. Amalgam mixed and set in presence of saliva and water.
15. Amalgam of physically mixed metals.

Approximately half the diagrams taken are included in Figure 2.

1. An attempt to produce fine powdered copper by electroplating at high current densities from an acid copper bath resulted in the so-called "burnt-out copper" deposits familiar to those who electroform copper dies for inlays.[17] The roentgen ray diffraction diagram revealed that, in addition to metallic copper, another compound, as yet unidentified, was deposited and that this compound was present to a considerable extent, estimated on the basis of the relative intensities of the lines to be approximately 40 per cent of the total. The predominant d spaces of this unidentified compound are 2.35, 1.52, 2.14; other reflections occurred, corresponding to d spaces of 2.29, 1.24, 0.976, 0.869 and 0.820 A.U.

Using so-called chemically pure fine copper powder showed that the "pure" copper had traces of another substance which was easily identified as cupric oxide.

The lines of the copper were broadened considerably owing to the fineness of the particles. This illustrates another use of roentgen ray patterns—to determine particle and crystallite size, in addition to qualitative and quantitative analysis.

2, 3, 4. Silver, zinc and tin produced patterns exactly characteristic of those published in the card index system.

5. Mercury being a liquid and noncrystalline gave the typical appearance of a noncrystalline material—a diffuse halo, instead of sharp lines. The halo corresponded approximately to a predominant spacing of 3.2 A.U.

6. When the powdered silver, tin, copper and zinc were physically mixed together in the proportions usually found in dental alloy (approximately 67, 25, 6 and 2 per cent, respectively) a complex diagram was obtained which showed, predominantly, the lines of silver. The lines of tin, copper and zinc could also be identified in the pattern.

7. However, when these metals were alloyed (for the purpose, a commercial dental alloy was used) a surprising result was obtained. From the resulting pattern, none of the individual constituents could be recognized. There was no simple mixture or solid solution. A new crystalline structure resulted—a new compound with predominant d spaces at 2.28, 2.27, 1.36, 2.58, 1.75, 1.49, 1.27, 0.796 in order of decreasing intensity and other reflections corresponding to 2.50, 2.09, 1.25, 1.19, 1.00, 0.965, 0.903, 0.893 and 0.811 A.U.

Further roentgenographic studies would be necessary to determine the exact nature of this alloy. For example, is an intermetallic compound of silver and tin formed with copper and zinc in solid solution? The exact size of the unit cell and the location of the atoms in the unit cell could be determined by further roentgenographic studies.

8. When this amalgam alloy was amalgamated and allowed to set, an entirely different diagram was obtained—a com-

17. Frankel, C. B. Scientific approach to the solution of practical problems encountered in electroforming copper dies. J.A.D.A. 32:1130 (Sept.) 1945.

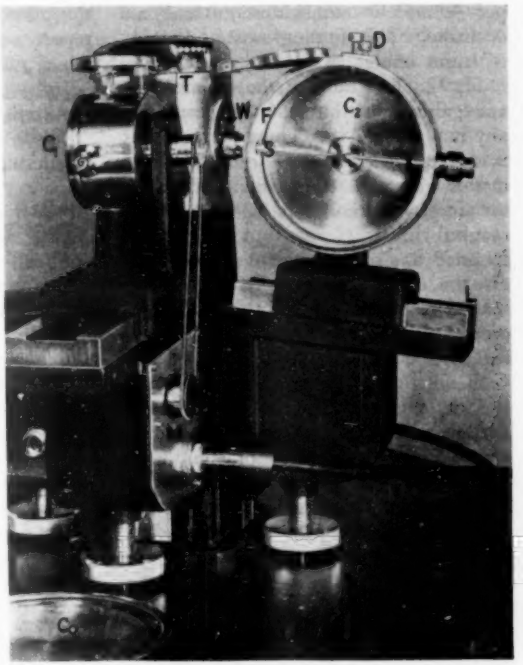


Fig. 4 • Debye-Scherrer Cameras, C_1 and C_2 with diameters of 57.3 and 114.6 mm., set up with an x-ray tube, T, on the desk of a Philips diffraction apparatus (same tube can be used for 1 to 4 cameras simultaneously). Each camera rests on a flat track, L. Roentgen ray beam leaves tube and is filtered with appropriate filter at W. Resulting essentially monochromatic beam enters slit system, S, which allows only essentially parallel beams to strike specimen mounted in center of camera (D is pusher type centering device). Undeviated, transmitted beam is absorbed by stop, X, which has black paper, fluorescent screen and lead glass window, G, for observing primary beam and shadow of specimen during exposure. Diffracted beams strike film, F, lining the camera. C_3 is cover for camera, C_2, removed to show inner construction of camera which is loaded and closed in the dark room. M is motor used to rotate specimen during exposure to help assure random orientation of crystal planes. (Courtesy of W. Parrish and North American Philips Company)

plex pattern with predominant reflections corresponding to d spaces at 2.34, 1.36, and 1.23. Upon analysis it was definitely established that a compound with the formula Ag_2Hg_3 (an intermetallic compound of two atoms of silver and three atoms of mercury) was present to the greatest extent and contributed practically all to the roentgen ray diagram. This compound is identical to the naturally occurring mineral, moschellandsbergite. Also present to some small extent and in the form of larger crystals was another intermetallic compound with the formula Cu_3Hg_4. Traces of pure tin and minute traces of pure zinc and copper were also demonstrated. Apparently, in amalgamation the mercury removes all the silver from the complex structure of the alloy and forms a new compound Ag_2Hg_3. Similarly some, not all, the copper is removed to form Cu_3Hg_4. Traces of pure tin and minute traces of pure zinc and copper were also demonstrated; tin and zinc plus some copper separate out in pure form scattered at random throughout the mass and possibly in solid solution one with the other. No trace of the alloy itself remains. The purpose of alloying then, it would seem, is to assure an equal distribution of the copper, tin and zinc throughout the amalgamated mass. The function of these impurities probably is to interfere with rapid crystallization of Ag_2Hg_3 and to reduce the size of the crystals. The accuracy of this assumption can be tested by further roentgenographic studies.

9. Set, amalgamated pure silver powder gave the pattern of Ag_2Hg_3. No silver in uncombined form could be demonstrated.

10. Amalgamated copper, however, gave the picture of Cu_3Hg_4 and pure cop-

per—complete amalgamation had not occurred. This finding was in keeping with the amalgamated alloy study.

11, 12. Diagrams of the tin and zinc amalgams failed to reveal the presence of any new compound. There were merely evidences of a solid solution of these metals with mercury. In the case of zinc the lines were similar in intensity to the regular zinc intensities but they corresponded to slightly larger d spaces. With tin the lines corresponded to slightly smaller d spaces, exactly as theory would predict, in accordance with their relative atomic radii.

13. A study of the effect of excess mercury in the mixture of regular dental amalgams showed that all corresponding predominant spaces of the amalgam were present, but they became much larger. There was an expansion of the unit cell. For example, some of the d spaces for dental amalgam as compared with the corresponding spaces for excess mercury amalgam are listed here.

Amalgam	Excess Hg amalgam
2.34	2.37
1.36	1.37
1.23	1.24+
1.14	1.14+
2.65	2.69
2.74	2.78

This indicates the probability of the Ag_2Hg_3 and Hg being in solid solution.

14. The effect of moisture in the amalgam mixture seemed to be that of increasing the crystallite size and preventing the close packing of the crystals, producing weaker amalgam. This finding does require further roentgenographic verification, however.

15. When an amalgam composed of the same metals in the proportion found in alloy but physically mixed (not alloyed) was made, no difference could be demonstrated as far as composition goes, between it and the amalgamated alloy. This tends to support the assumption of the purpose of alloying as stated in this report.

THEORY OF THE SETTING OF DENTAL AMALGAMS

By means of simple roentgen ray diffraction studies, it was definitely established that the setting or hardening of dental amalgams is due to the formation of an intermetallic silver-mercury compound with the formula Ag_2Hg_3. The experimental results indicate that amalgam alloy is a compound rather than a simple solid solution and that it may be an intermetallic compound of silver and tin with copper and zinc in solid solution. The constituents other than silver in the amalgam alloy do not contribute to the hardening or setting but rather modify the properties of the set mass. The presence of one other new compound, Cu_3Hg_4, in small amounts in the hardened amalgam was demonstrated. Other components are copper, zinc and tin in pure form and in solid solution with mercury and possibly with Ag_2Hg_3. No other intermetallic compounds were found and no unaltered alloy was present.

A comparison of these findings should be made with existing theories. There is nothing new in the finding that amalgam alloy represents a new compound rather than the usual solid solution. Murphy[18] confirmed findings of Kneght and Joyner[19] and Gray[20, 21] that Black's alloy was essentially Ag_3Sn. Gaylor[22] also agreed that this formula represented amalgam alloy and stated that if tin is present in the alloy in greater amounts than 27 per cent, free tin is present in addition to

18. Murphy, A. J. Dental amalgam alloys. J. Inst. Metals 35:107, 1926.

19. Kneght, and Joyner, R. A. Dental amalgam. J. Chem. Soc. 103:2247, 1913.

20. Gray, A. W. Dental amalgam. Phys. Rev. 19:405, 1922.

21. Gray, A. W. Dental amalgam. J. Inst. Metals 29:139, 1923.

22. Gaylor, M. L. V. Dental amalgam. J. Inst. Metals 60:407, 1937.

Ag_3Sn; also, when copper is added up to 5 per cent a solid solution of copper in Ag_3Sn results. Apparently, Ag_3Sn is the intermetallic compound we suspected made up the alloy. The exact formula of this compound can be accurately determined by roentgenographic methods as follows: to fixed quantities of pure silver add and alloy increasing amounts of tin. By analyzing powder diagrams of each alloy it could definitely be determined at what proportion of silver and tin the new compound forms. Further roentgenographic studies may be made to determine the lattice constants; that is, size of the unit cell and the position of the atoms in the unit cell. Often it is only by such roentgenographic analysis that structure can be determined in these cases. Chemical analysis can only tell how much silver and how much tin are present but not how they are combined.

Kneght and Joyner[19] stated that, essentially, the amalgamation reaction could be stated as follows:

$$Ag_3Sn + 4\ Hg \longrightarrow Ag_3Hg_4 + Sn$$

Gray[20, 21] was in agreement with this equation. Gaylor[22] stated that such representation was too simple and that three complex phase reactions occurred as the mass set and that formation of Ag_3Hg_4 and tin from the alloy and mercury represented only the final product. Troiano[23] confirmed Gaylor's equilibrium diagrams but not his theory of setting. He gave the following reaction as representing the final set.

$$7\ Ag_3Sn + 29\ Hg \longrightarrow 7\ Ag_3Hg_4 + Sn_7Hg$$

He also stated that some Ag_3Sn is unattacked by the mercury and he found that, when 40 per cent or more of mercury was used in amalgamation, no tin lines could be found. Troiano's theory is generally accepted today as the true reaction for the setting of amalgam.

Our findings have indicated, rather definitely, however, that no tin-mercury compound (Sn_7Hg) forms. Our studies show that mercury goes into solid solution with tin resulting in decreased d spaces of the tin pattern and no new compound is present. Evidences of unattacked alloy also were lacking in our studies.

All reaction equations that have been suggested in previous studies show that the chief yield is an intermetallic silver mercury compound with the formula Ag_3Hg_4 as compared to our findings Ag_2Hg_3. The complex pattern we obtained when silver was amalgamated and allowed to set was identical in every respect with the published pattern of a compound listed as Ag_2Hg_3 in the A.S.-T.M. card index. Since the agreement on this complicated spectrum was perfect, there can be no question that our compound was identical to the one listed under the formula Ag_2Hg_3. The pattern also agreed in detail with that obtained from the set amalgamated amalgam alloy with the exception that the amalgam, in addition, showed other faint lines representing the other components present.

The Ag_3Hg_4 formula of previous studies was determined before roentgen rays were in use for analysis. Later studies assumed the same formula and all papers were published before the A.S.T.M. card index and other catalogues were published. To determine whether the A.S.-T.M. formula of Ag_2Hg_3 or the previously published formula of Ag_3Hg_4 is the correct one, simple experiments, similar to those suggested for determining the formula of the silver-tin compound may be performed. Successively larger amounts of mercury must be used to amalgamate fixed amounts of silver and roentgen ray powder diagrams taken for each step. At the point where all silver lines disappear and only those of the silver-mercury compound are found, and before increased d spaces because of excess mer-

23. Troiano, A. R. An x-ray study of dental amalgams. J. Inst. Metals 63:247, 1938.

cury occur, there appear the proportions of silver and mercury quantitatively. However, the fact that the A.S.T.M. index does list the crystal system as cubic and gives the lattice constants indicates that the compound was well "worked up" before being included in the index.

SUMMARY AND RECOMMENDATIONS

Simple roentgen ray diffraction studies indicated certain facts regarding the setting of dental amalgam that was at variance with the old accepted theory. On the basis of these facts it can definitely be concluded that essentially the amalgam filling is composed of an intermetallic compound with the formula Ag_2Hg_3.

A discussion of some of the simpler aspects of roentgen ray diffraction theory was given together with references to its application in other dental studies. Centers of dental research, particularly the dental schools, should investigate more thoroughly the potentialities of roentgen rays as tools in dental research.

510 Ocean Avenue

One Way to Reach Them • Leadership must fulfill the spiritual as well as the material needs of man. It must be the kind of leadership that opens the door to truth and understanding, and must recognize the part that the heart plays in any human undertaking. I think that Richard L. Evans analyzed this quite well when he said: "The pattern of human conduct would seem to indicate that there are many ways of moving men, but only one way that may be depended upon to result in permanent good for all. You can push men around with a strong arm. You can overwhelm them with authority. You can stampede them with fear and panic. You can confuse them with falsehood. You can wear them down with insistent argument. But the only way of moving them willingly and effectively, and of keeping them moving in the right direction, is to touch their lives and their hearts with truth, to open their minds to the light of truth . . . to show them sound ways which they will pursue of their own free will, without being pushed or coerced or deceived. To push men around, to enslave them, to coerce them, to regiment them is a thankless job, and one that holds difficulty for all and satisfaction for none. But to touch them in their hearts and their thoughts, to convert them to truth, to transform their lives from within rather than to force them from without, is a glorious and satisfying experience for all concerned." *H. M. Nordberg, vice-president of Pitney-Bowes, Inc., quoted in Industrial Medicine and Surgery 20:416, September, 1951.*

Cases and Comments

EFFECTIVE ANTIBIOTIC THERAPY IN OSTEOMYELITIS OF THE MANDIBLE WITHOUT SURGERY: REPORT OF A CASE

By Albert J. Whitfield, D.D.S., San Francisco

The patient, a 47 year old white man, was referred to this office September 18, 1950, with an acute cellulitis of the left cheek, the cervical and both submental regions. He complained of excruciating pain in the left submental region accompanied by difficulty in swallowing.

History • One month prior to this visit the patient had a mandibular left second molar extracted under local anesthesia. He stated there was little postoperative pain and no swelling. One week before examination, swelling and exquisite pain began in the left cervical region and the swelling gradually became diffused. Hot compresses were applied by the patient.

Oral Examination • The floor of the mouth, gums and gingivae on the left side were edematous and inflamed. The mandibular six anterior teeth, the left first and second bicuspids and the first molar were tender to percussion and loose with a possibility of their exfoliation. The mandibular second molar socket appeared to be healing satisfactorily and the maxillary teeth and gingivae seemed normal. The temperature was 101 F., the pulse rate 85, and the respiratory rate 20.

Laboratory Data • A smear taken from the necks of the involved mandibular teeth and the floor of the mouth showed an abundance of fusiform bacillae, Vincent's spirals and pus cells. Frank pus was unavailable for examination. Wassermann and urine tests were negative. The total leukocyte count was 9,100 with a differential count of 48 per cent neutrophils (46 per cent filamented and 2 per cent nonfilamented), 45 per cent lymphocytes, 5 per cent monocytes, 1 per cent eosinophils, and 1 per cent basophils. Clotting and bleeding time were within normal limits.

Roentgenographic Examination • Examination of lateral jaw roentgenograms revealed a line of demarcation extending along the inferior border of the mandible from a point anterior to the mandibular second molar socket to an area below the apex of the mandibular left cuspid. Sequestration had begun (Fig. 1).

Diagnosis • The diagnosis was acute osteomyelitis of the left inferior border of the mandible, cellulitis of the left cheek, the left cer-

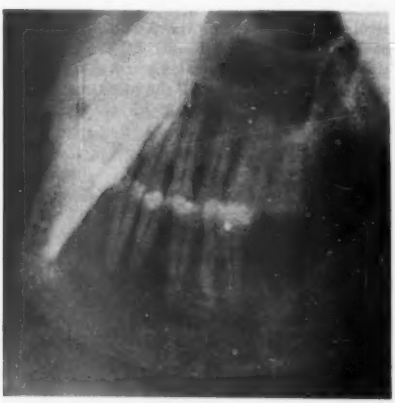


Fig. 1 • Lateral jaw roentgenogram showing acute osteomyelitis with sequestration of left inferior border of mandible

Fig. 2 • Lateral jaw roentgenogram taken Oct. 17, 1950, showing disappearance of sequestration with additional resorption

Fig. 3 • Final roentgenogram showing smooth inferior border with absence of sequestration and infection. Bone regeneration has begun

vical and both submental regions, accompanied by acute ulceromembranous gingivitis.

Treatment and Course • Judging from the former accepted standards of treatment and the clinical and roentgenographic data as presented here, immediate surgery for drainage and the removal of the sequestrum would have been mandatory. Since the advent of antibiotics, however, rational therapeutic procedures have completely changed. It has been found expedient to minimize acute symptoms of infection with the aid of chemotherapy before surgery. Therefore immediate preoperative treatment was begun.

Treatment consisted of daily injections of 600,000 units of penicillin G procaine in aqueous suspension. This treatment was supplemented with aureomycin, 250 mg., every four hours. Twelve aureomycin capsules were prescribed at this time and repeated again on October 17, 1950. These two antibiotics were selected because of their wider antibacterial activity against gram-positive and gram-negative organisms usually associated with this type of infection. Pain was controlled with codeine phosphate (grains ½) and Empirin compound (grains 5) as needed. The infected tissues of the mouth were cleansed daily with equal parts of hydrogen peroxide and water and then sprayed with a 2 per cent chromic acid solution. Ice packs were applied to areas affected with cellulitis. Pain ceased on the second day following this prescribed treatment. Cellulitis of the soft tissue areas began to subside following the third treatment. Swelling was barely perceptible six days later. Oral treatment and parenteral penicillin therapy were administered daily until September 28, 1950. The ulceromembranous gingivitis responded immediately following the initial treatment and the teeth became firm. From September 28, 1950, parenteral penicillin therapy and oral treatment as previously described were continued on alternate days until October 17, 1950, at which time no intraoral or extraoral signs of infection were apparent.

Lateral jaw roentgenograms were again taken on this date and showed further resorption of the bone in the left inferior border (Fig. 2). The large sequestrum had disappeared (Fig. 1). However, because of the possible presence of bacterial strains highly resistant to penicillin it was deemed advisable to prescribe 12 additional 250 mg. capsules of aureomycin.

The patient was dismissed until December 11, 1950, at which time he returned for roentgenographic follow-up. No sequestration was seen in these films. The left inferior border of the mandible appeared to have been saucerized. The base of the saucerization appeared normal in density with no apparent evidence of further infection. Roentgenograms on February 13, 1951 showed the left inferior border of the body of the mandible to be smooth, without sequestra or infection (Fig. 3). Bone regeneration was evident.

Conclusion • This case suggests the value of antibiotics in the treatment of acute osteomyelitis. In this specific instance surgery was precluded with a complete and uneventful resolution of the condition. At no time did the patient manifest symptoms of sensitivity to either penicillin or aureomycin. He resumed work three days following the initial treatment. It is of interest that other clinicians examining the roentgenograms thought the sequestrum had been surgically removed.

450 Sutter Street

FOREIGN BODY IN TONGUE: REPORT OF A CASE

By Eduard Georg Friedrich, D.D.S., Commander (DC), U. S. Naval Reserve, U. S. Naval Hospital, Great Lakes, Ill.

The patient, a 20 year old white marine, was admitted to the U. S. Naval Hospital, Great Lakes, Ill., for plastic repair of a scar on the left side of the face (Fig. 1). During combat with the 1st Marine Division in Korea the

Fig. 1 • Appearance of patient at time of admission, showing scar on left side of face

which was held in balance by the surrounding muscles (Fig. 2). Location of the ectopic tooth was confirmed by an intraoral occlusal roentgenogram. In addition, clinical examination disclosed a fistulous opening in the floor of the mouth opposite the left third molar area (Fig. 3).

Under intratracheal anesthesia a sound was introduced into the fistulous tract. The opening was enlarged by sharp dissection and the tooth was removed with straight Kelley forceps. The wound was closed with three black silk sutures and the recovery was uneventful.

The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

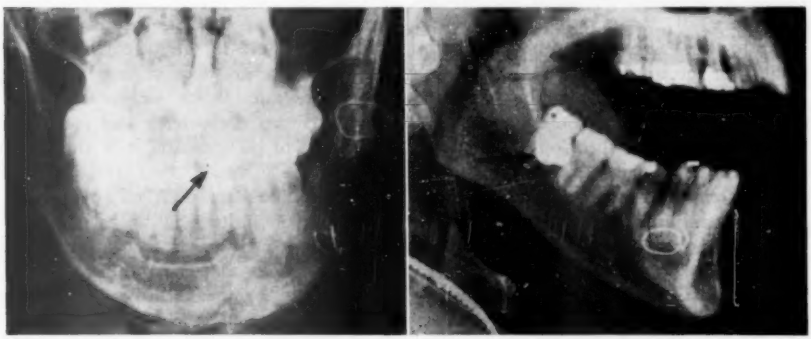


Fig. 2 • Left: Posteroanterior view, showing tooth in midline of tongue. Note wires at each end of graft. Right: Lateral view

patient sustained a fractured mandible. After receiving emergency treatment at a battalion aid station he was immediately evacuated to a hospital ship. At this installation an open reduction of the fractured mandible was attempted by direct fixation with nonabsorbable material. The patient was then transferred to a hospital in Japan where reduction and fixation were again undertaken. He was subsequently sent to a hospital on the west coast of the United States for further treatment which consisted of placement of an autogenous ilial graft. The implant was fixed to the proximal and distal fragments of the host by one wire at each end.

Prior to attempting any corrective procedures, posteroanterior and lateral roentgenograms of the skull were taken to determine the position and condition of the graft. The films revealed a tooth in the midline of the tongue,

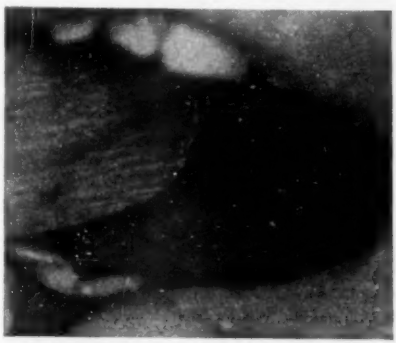


Fig. 3 • Fistulous opening in floor of mouth opposite left third molar area

COUNCIL ON DENTAL THERAPEUTICS

Status report on Tar-Gon Dental Stick

Numerous inquiries concerning Tar-Gon Dental Stick directed to dentists and dental hygienists have been referred to the office of the Council on Dental Therapeutics. The product has been submitted for the consideration of the Council, but in view of the fact that the item is designed only for cosmetic purposes, it is the opinion of the Council that the product is not eligible for listing in *Accepted Dental Remedies.* In view of the numerous inquiries, however, the Council has authorized the publication of this report.

Tar-Gon Dental Stick is stated to contain precipitated calcium carbonate and talc as the principal ingredients, together with smaller amounts of other substances added principally for the purpose of coloring the product and molding it into its pencil-shaped form. Tests on extracted teeth by a Council consultant, together with a limited examination of the product in the Association's chemical laboratory, indicate that the abrasives presently employed in the manufacture of the product are equivalent to those which are suitable for inclusion in dentifrices. From these tests and from the statement of composition it is the opinion of the Council that the product would not be hazardous except for the possibility of undesirable abrasion resulting from too frequent or too vigorous use.

It is obvious that the product may be expected to be useful only for the removal of superficial, accessible stains. It should be emphasized that the use of this product is in no way a substitute for proper and regular toothbrushing, or the cleansing procedures employed in a dental prophylaxis.

Council announces classification of additional products

The classification of products by the Council on Dental Therapeutics of the American Dental Association has been described in a previous report (*J.A.D.A.* 40:489, April, 1950). The Council's program now provides for classification of products in Group A, Group B, Group C and Group D. Products are reconsidered periodically and decisions are subject to change at any time that a substantial amount of new evidence becomes available. The files of the Council contain information on many drugs and dental cosmetics, and inquiries are welcome.

GROUP A

Listing of products in Group A means that at the time of their consideration, the items conformed with the provisions of acceptance established by the Council on Dental Therapeutics and adopted by the Board of Trustees and the House of Delegates of the American Dental Association. Items in this group will be listed in *Accepted Dental Remedies,* and may use the Seal of Acceptance, unless otherwise provided.

The following additional products are classified in Group A:

Crystalline Penicillin Potassium G Buffered Tablets, 50,000 Units, 100,000 Units, 250,000 Units and 500,000 Units (Chas. Pfizer & Co., Inc.): Stated to contain penicillin G potassium, calcium carbonate, excipients and flavor. See *A.D.R.*, ed. 17, p. 65.

Crystalline Penicillin Potassium G Tablets (Soluble), 50,000 Units, 100,000 Units (Chas. Pfizer & Co., Inc.): Stated to contain penicillin G potassium. See *A.D.R.*, ed. 17, p. 65.

Crystalline Penicillin Potassium G Troches, 10,000 Units (Chas. Pfizer & Co., Inc.): Stated to contain penicillin G potassium in a flavored base. See *A.D.R.*, ed. 17, p. 65.

Penicillin G Procaine, 300,000 Units per cc., for Aqueous Injection (Chas. Pfizer & Co., Inc.): Addition of water for injection gives a suspension in which each cc. contains penicillin G procaine, 300,000 units with suspending and dispersing agents. In vials containing 300,000, 1,500,000 and 3,000,000 units. See *A.D.R.*, ed. 17, p. 65.

Penicillin G Procaine in Aqueous Suspension, 300,000 Units per cc. (Chas. Pfizer & Co., Inc.): Each cc. of aqueous suspension is stated to contain penicillin G procaine, 300,000 units with suspending and dispersing agents. In 1 dose vials with disposable syringe and 10 dose vials. See *A.D.R.*, ed. 17, p. 65.

Penicillin G Procaine in Oil, 300,000 Units per cc. (With Aluminum Monostearate) (Chas. Pfizer & Co., Inc.): Each cc. of suspension is stated to contain penicillin G procaine, 300,000 units in sesame oil containing 2 per cent aluminum monostearate. In 1 and 10 dose vials. See *A.D.R.*, ed. 17, p. 65.

Penicillin G Procaine Crystalline with Buffered Penicillin G Sodium Crystalline for Aqueous Injection (Chas. Pfizer & Co., Inc.): Addition of water for injection, 5 per cent dextrose solution or isotonic sodium chloride solution gives a suspension in which each cc. is stated to contain penicillin G procaine, 300,000 units, penicillin G sodium, 100,000 units, with suspending and dispersing agents. In 1, 5 and 10 dose vials. U. S. Trademark: Pronapen. See *A.D.R.*, ed. 17, p. 65.

Procaine HCl 2%, Epinephrine 1:25,000 (The William A. Webster Co.): Each cc. is stated to contain procaine HCl, 0.02 Gm.; epinephrine (as hydrochloride), 0.00004 Gm.; sodium chloride, 0.005 Gm.; sodium bisulfite, 0.0019 Gm., and distilled water. Marketed in 2.2 cc. cartridges. See *A.D.R.*, ed. 17, p. 17.

Procaine HCl 2%, Epinephrine 1:50,000 (The William A. Webster Co.): Each cc. is stated to contain procaine HCl, 0.02 Gm.; epinephrine (as hydrochloride), 0.00002 Gm.; sodium chloride, 0.005 Gm.; sodium bisulfite, 0.0019 Gm., and distilled water. Marketed in 2.2 cc. cartridges. See *A.D.R.*, ed. 17, p. 17.

GROUP B

Listing of products in Group B means that there is insufficient evidence to justify their present acceptance, but there is reasonable evidence of their usefulness and safety. These products meet the other qualifications and standards established by the Council on Dental Therapeutics and the Division of Chemistry. It is the Council's opinion that Group B prod-

ucts may be promoted for special use and study.

GROUP C

Listing of products in Group C means that the evidence is so limited or inconclusive that the products cannot be accurately evaluated. It is the Council's opinion that Group C products require further study by qualified investigators.

GROUP D

Listing of products in Group D means that they are unacceptable because of their demonstrated inability to meet the standards outlined in the provisions for acceptance.

COUNCIL ON LEGISLATION

Testimony of the Association on fluoridation of municipal water supplies before the House of Representatives Select Committee to Investigate the Use of Chemicals in Foods and Cosmetics

Persons who drink from a community water supply which is fluoridated properly will not thereby incur any physiological or systemic disorders. That was the central theme of the American Dental Association's testimony presented before a Select Committee of the House of Representatives on February 28 by J. Roy Doty, secretary of the Council on Dental Therapeutics. Bernard J. Conway, assistant secretary of the Council on Legislation, assisted Dr. Doty in answering pointedly hostile questions asked by the Committee's chief counsel.

The Select Committee has been assigned the task of investigating the addition of chemicals to foods and cosmetics and devoted almost two weeks to hearings on the safety and benefits of adding fluorides to community water supplies.

The Association requested an opportunity to be heard after witnesses opposing fluoridation, invited to appear by the Committee, had more than a fair opportunity to present their arguments. The Committee, evidently acting on the recommendation of the American Dental Association, later extended invitations to the American Medical Association, the Association of State and Territorial Health Officers, the American Public Health Association, and the National Research Council. Representatives of those groups testified or presented statements to the Committee supporting the safety of fluoridation.

Dr. Doty's statement to the Committee follows.

Mr. Chairman and Gentlemen of the Committee:

I am Dr. J. Roy Doty of Chicago, Illinois, formerly a research biochemist and physiologist and now on the staff of the American Dental Association in the capacity of secretary of the Association's Council on Dental Therapeutics. I am here today to explain the considerations which led the American Dental Association to endorse the controlled fluoridation of fluoride-deficient municipal water supplies. With me is Mr. Bernard J. Conway, assistant secretary of the Association's Council on Legislation. Each of us will welcome any questions that bear upon his particular field.

The House of Delegates of the American Dental Association, its policy-making body, adopted a resolution endorsing fluoridation of municipal water supplies at its 1950 annual session. That resolution declares:

Whereas, numerous studies have demonstrated a decreased incidence of dental decay associated with the presence of fluoride occurring naturally in drinking water, and

Whereas, there is a rapidly accumulating body of data derived from direct studies of the artificial addition of fluoride to drinking water, and

Whereas, these data provide convincing evidence of the safety of this procedure and of its benefits in terms of reduced incidence of dental caries, therefore be it

Resolved, that in the interest of public health, the American Dental Association recommends the fluoridation of municipal water supplies when the fluoridation procedure is approved by the local dental society and utilized in accordance with the standards established by the responsible health authority, and be it further

Resolved, that the American Dental Association recommends the continuation of controlled studies of the benefits derived from the fluoridation of water supplies.

The resolution stresses four fundamental points which are essential to a discussion of the Association's stand on fluoridation: first, the resolution is premised on an evaluation of studies and scientific data pertaining to fluoridation; second, it is founded on the scientific data evidencing fluoridation's safety to human beings as well as its dental benefits; third, it declares that the fluoridation procedure should be in accordance with the standards established by the responsible health authority; and fourth, it recommends that controlled studies of its benefits continue. The responsibility for evaluating research in the many areas that affect dentistry and dental health is assigned to a number of the official agencies of the Association. The agencies which have given consideration to fluoridation of water supplies at various times are the Council on Dental Health, the Council on Dental Research, and the Council on Dental Therapeutics. Members of these agencies are Association members selected because of their special competence in the field of dental research and in the evaluation of research reports. To buttress the efforts of its evaluating agencies the Association appoints consultants and advisers when necessary and, in addition, employs full-time staff members, experts in the field of their parent councils.

The scientific data pertaining to fluoridation are an accumulation of studies and reports over a period of more than 40 years. It includes all available data on "mottled" dental enamel reported before it was known that excessive fluoride in the drinking water caused this peculiar condition. It includes all available data on the beneficial dental effects of appropriate concentrations of fluoride in the drinking water reported since it has been determined that fluorides do affect the structure of teeth. Finally, it includes all available data dealing with the possibility of harm to human beings caused by drinking fluoride-bearing water. More than seven years ago an agency of the Association made a survey of the evidence then available and concluded that the presence of one part per million fluorine in a water supply is desirable, but the agency did not recommend routine use of fluoridation. The Association carefully withheld its endorsement of fluoridation until another six years of observation and study provided such convincing evidence of its safety and dental benefits that the dental scientists on the evaluating committees believed they could no longer refrain from endorsing the procedure. The Association's endorsement of controlled fluoridation occurred only after an intensive evaluation of all such data.

I have mentioned the reports and studies connected with the peculiar condition of "mottled" dental enamel. Observations of this condition were reported as early as 1909 by Doctors F. S. McKay and G. V. Black, eminent dental scientists. Actually, they observed and studied an experiment that nature was conducting on human beings. For more than 20 years only dental scientists were actively studying this apparently pathological condition evidently incurred by persons drinking water from certain sources. During that period of time there was little or no reputable medical evidence reported to suggest that other pathological conditions could be traced to what proved to be high levels of fluoride in the water. On the contrary, scientific findings

overwhelmingly support the conclusion that fluorides in drinking water at concentrations even several times that necessary to produce dental fluorosis, are not otherwise harmful to human beings.

At approximately the same time that fluoride in water supplies was determined to be the cause of dental fluorosis, dental scientists were reporting findings that the incidence of dental decay appeared to be significantly lower in persons afflicted with dental fluorosis. After it became known that fluoride was the causative agent, water supplies in a number of areas in the United States were analysed. Scientists discovered wide variations in the amount of fluorides present in these waters. Where objectionable dental fluorosis occurred, the concentration was ordinarily found to be several parts per million, in some cases up to 15 parts per million.

Dental fluorosis, however, was absent or inconspicuous where the concentration was below two parts per million. But the scientists also discovered that at a concentration of one part per million, at which ratio fluorosis did not present a problem, dental decay was as significantly retarded as in localities where dental fluorosis appeared. Thus in communities like Aurora and Joliet, Illinois, where fluoride is and has been naturally present at optimum concentration over a considerable period of time, persons who drank from those community supplies while their teeth were forming had a markedly lower caries rate than persons who did not have the benefit of fluoride during the formative period of the teeth. Furthermore, objectionable dental fluorosis in Aurora and Joliet is almost unheard of. Today dental scientists safely anticipate a reduction of 60 to 65 per cent of the number of cavities ordinarily expected in a given age group, if that group has been drinking fluoridated water during the dental formative years.

The prevalence of dental disease among the population of this country is extensive. Ninety-five per cent of our population is or will be affected with one form of dental disorder or another during a lifetime. Dental decay, furthermore, represents a very high percentage of the incidence of dental diseases afflicting mankind. Studies of the dental caries problem reveal that the nation's dental personnel cannot in the foreseeable future repair the effects of dental decay at a rate approaching the rate at which new carious lesions develop. The Association's primary responsibility is to protect and improve the nation's dental health. It has, therefore, a professional responsibility to recommend the proper utilization of preventive measures demonstrated to be effective in the control of dental disease. The Association would be delinquent in assuming its responsibility if it did not endorse and recommend preventive measures as soon as adequate demonstrations of their safety and practical usefulness are supported by sufficient scientific evidence. In endorsing and recommending the fluoridation procedure, the Association's evaluating agencies are of the opinion that every year that the fluoridation procedure is delayed leads unnecessarily to the denial of dental benefits to vast numbers of American children.

The safety of the fluoridation procedure recommended by the American Dental Association, as well as the benefits, is the particular concern of this committee. The procedure recommended calls for the addition of fluorides to water supplies which are naturally deficient in fluoride ion, in order to adjust the concentration of fluoride ion to approximately one part per million. Slight adjustments of that ratio may be desirable according to the quantity of water normally imbibed per individual in a particular geographical region; it will probably be lowered slightly in the warm climates and raised slightly in the cold climates; or it may have to be adjusted seasonally in areas which have long periods of both high and low temperatures. These modified ratios may be found to provide maximum dental benefits but are not of sufficient strength to cause dental fluorosis. I should further emphasize the fact that fluoride ions picked up by water in traversing subterranean formations are identical with fluoride ions introduced into water distribution systems through the addition of suitable fluoride compounds.

It may be desirable to consider a few of the reports that are of special interest in relation to the safety of fluoridation. As previously stated, dental fluorosis is regarded as the most sensitive physiological response to small amounts of fluoride. Another structure to which attention has been directed is the skeleton. McClure studied the possible relation of fluoride (F) in drinking water to bone fracture experience and height and weight of boys and young men. He could find no evidence of skeletal superiority resulting from residence in a nonfluoride area as compared to a fluoride area.[1]

Another important question is the possibility of accumulation of fluoride in the body. It has been estimated that the amount of fluorine

1. McClure, F. J. Fluoride domestic waters and systemic effects. I. Relation to bone fracture experience, height and weight of high school boys and young selectees of the Armed Forces of the United States. Pub. Health Rep. 59:1543 (Dec. 1) 1944.

ingested daily through drinking water containing one part per million fluorine is about one milligram.[2] It has also been shown that the elimination of ingested fluorine by way of perspiration, urine and feces is practically complete when the fluorine ingested does not exceed four to five milligrams daily.[3] A survey of the amount of fluorine in urine specimens of high school boys and young selectees shows that the concentration of fluorine in the urine is almost identical with the concentration in the drinking water up to about 4.5 parts per million.[4] Other excretion and balance studies have been reported by Machle and his associates which are in accord with the studies just described. Urine excretion studies have also been extended to include measurement before and after the addition of sodium fluoride to a public water supply. The results indicate that at least a very large proportion of the added fluoride is being eliminated as rapidly as it is ingested.[5]

Some surveys of the amount of certain types of kidney disease in fluoride as compared to non-fluoride areas have not produced any evidence of harmful effects on the kidneys by fluorine at the levels proposed for the fluoridation procedure. Renal injury in animals has been produced only by extreme doses of fluorine. Rats and swine showed kidney changes when their diet contained 200 to 800 parts per million of fluorine.[6]

The surveys and reports cited constitute only a part of the considerable scientific evidence attesting to the safety of the recommended fluoridation procedure. The Association maintains that there is more scientific evidence available to substantiate the safety of adding controlled amounts of fluorides to water than there is for the addition of any chemical to a food or food product. At this point let me emphasize that neither the Council on Dental Health nor the Council on Dental Therapeutics has recommended the addition of fluorides to foods.

The American Dental Association's evaluating agencies are not the only groups which have appraised the safety of fluoridation. The Council on Pharmacy and Chemistry and the Council on Foods and Nutrition of the American Medical Association, as well as the *ad hoc* Committee on Fluoridation of Water Supplies of the Division of Medical Sciences, National Research Council, have reported on the harmlessness of the procedure.

These scientific bodies have appraised the evidence appropriate to their findings in a manner similar to that used by the American Dental Association's evaluating agencies. These groups, not allied in any way with the American Dental Association, considered the evidence pertaining to all physiological effects. Medical, as well as dental scientists, then, are convinced of the complete safety of the Association's recommended fluoridation procedure.

In recommending to its state and local societies that they seek to accomplish fluoridation of water supplies in their respective areas, the Association's evaluating agencies explicitly state that the procedure be in accordance with standards established by the responsible health authority. Obviously, the safety of fluoridation in operation depends on establishing proper standards and employing expert control for the procedure and installation; that is, standards for the appropriate amount of fluoride to be added and control over the maintenance of the equipment. The latter will require both approved equipment and personnel adequately trained to keep the fluoride introduction at the specified level.

In the more than 200 municipalities that have fluoridated their water supplies, no serious problems have occurred. The process is relatively simple from an engineering and maintenance viewpoint. Both large and small municipalities have been able to fluoridate their water supplies efficiently and economically. Studies designed to improve the mechanics of fluoridation as well as to increase its dental benefits will continue.

This brings me to the final point contained in the Association's statement of policy. The American Dental Association recommends that controlled studies of fluoridation's benefits continue. The Association wishes to assure this committee that a thorough scientific appraisal of all of the reported effects of fluoridation will continue. As in the past any reported effect will receive attention. The Association is sincerely convinced that no pathological conditions will result from proper fluoridation. An unobjectionable form of dental fluorosis may appear in a small percentage of children. It is obvious, too, that

2. McClure, F. J. Ingestion of fluoride and dental caries. Quantitative relations based on food and water requirements of children one to twelve years old. Am. J. Dis. Child. 66:362 (Oct.) 1943.

3. McClure, F. J., and others. Balances of fluorine ingested from various sources in food and water by five young men. Excretion of fluorine through the skin. J. Indus. Hyg. and Toxicol. 27:159 (June) 1945.

4. McClure, F. J., and Kinser, C. A. Fluoride domestic waters and systemic effects. II. Fluorine content of urine in relation to fluorine in drinking water. Pub. Health Rep. 59:1575 (Dec. 8) 1944.

5. Nondental effects of trace quantities of fluorine, in Dental caries and fluorine, Moulton, F. R., editor, Washington, D. C., American Association for the Advancement of Science, 1946, p. 78.

6. Kick, C. H., and others. Fluorine in animal nutrition. Ohio Agric. Exp. Sta. Bul. 558, 1935.

the interests of medical and related scientific groups in the nondental effects of fluoridation will keep pace with the Association's primary interest in the dental effects. In conclusion I would like to recommend in behalf of the American Dental Association that this committee, if it has not already done so, request a statement from, or extend an invitation to these eminent scientists: F. S. McKay, Colorado Springs, Colorado, W. D. Armstrong, University of Minnesota, H. T. Dean, National Institute for Dental Research, Philip Jay, University of Michigan, F. A. Arnold, National Institute for Dental Research, O. K. Sagen, Division of Vital Statistics and Records, Springfield, Illinois, C. J. Cox, University of Pittsburgh, F. A. Bull, Director of Dental Education, State Board of Health, State Office Building, Madison, Wisconsin, D. B. Ast, Director, Bureau of Dental Health, New York State Department of Health, Edward R. Schlesinger, Director Bureau of Maternal and Child Health, New York State Department of Health, Elias Elvove, National Institute of Health, F. J. McClure, National Institute for Dental Research, H. C. Hodge, University of Rochester, Isaac Schour, University of Illinois, Joseph C. Tam, University of Minnesota, R. F. Sognnaes, Harvard University, J. F. Volker, University of Alabama, E. J. Largent, University of Cincinnati, College of Medicine, H. B. McCauley, Baltimore City Health Department, A. L. Russell, U. S. Public Health Service, Thomas J. Hill, Western Reserve University.

This is a representative but not complete list of scientists who have reported data obtained in surveys of human population groups or in animal experiments which are pertinent to the subject of water fluoridation. If the Committee desires, I shall present a number of statements and reports that the Association believes should be part of the record.

In behalf of the American Dental Association may I thank you for the privilege of appearing here today.

COUNCIL ON DENTAL RESEARCH

Product added to A.D.A. list of certified dental materials

Since the publication of the most recently revised List of Certified Dental Materials (*J.A.D.A.* 43:78, July 1951) and the Products Added to A.D.A. List of Certified Dental Materials (*J.A.D.A.* 43:495, October 1951; 44:81, January 1952; 44:326 March 1952; 44:449 April 1952) the following material has been added.

CERTIFIED DENTURE RESINS
(A.D.A. SPECIFICATION NO. 12)

Material	*Form*	*Manufacturer or Distributor*
Enciton	Pink; powder-liquid	The L. D. Caulk Company

MAY 1952

LON W. MORREY, D.D.S., EDITOR
VOLUME 44 • NUMBER 5
Published by the American Dental Association
222 East Superior Street • Chicago 11, Illinois

THE Journal OF THE AMERICAN DENTAL ASSOCIATION

Editorials

Ten cent arguments against fluoridation

Despite the fact that more than 250 communities in the United States have fluoridated their water supply and at least an equal number are now considering the process favorably, there are a number of city authorities that have rejected the proposal and there lingers an element of doubt in the minds of others as to the propriety of the procedure. Arguments against fluoridation range from the rational reasoning of the scientific minded citizen to the hysterical vocalizing of the emotional antagonist. Many of the latter arguments are absurd but apparently many are effective. Many are to be found in a little known publication entitled *Americanism Bulletin* edited by a self-styled world traveler and news analyst, W. D. Herrstrom, of Faribault, Minnesota.

Editor Herrstrom, campaigning against the fluoridation of community drinking water, has gone to no end of trouble to compile a list of arguments indicating the harmful results of adopting a fluoridation program. First and foremost, cautions the Faribault news analyst, "our national health services are promoting this scheme. They are operating under the same political bosses who told us that Bolshevik Russia and Communism were harmless. . . . The same political bosses are . . . for socialized medicine and fluoridation is socialization entering through the back door."

Dragging in communism, socialism, or even the everyday garden variety of American politics is inexcusable when discussing the pros and cons of a public health measure such as water fluoridation. Both the American Dental Association and the American Medical Association have approved the fluoridation program and both associations for years have waged unceasing war on government control of health services.

The Faribault editor plays further on the fears of a war wearied world by warning that "the mechanism for fluoridation of water supplies in any community would provide the perfect weapon for saboteurs. With large amounts of the fluorides in storage the enemy could dump these into the water supplies and destroy all the people in the community." This sounds like something found in the wildest "who-done-it"—something which even world traveler Herrstrom knows is untrue. Cox and Ast[1] point out that even in the case of gross negligence it would require more than four tons of sodium fluoride per million gallons of water processed to produce a concentration of 450 ppm fluorine—sufficient to produce salivation and vomiting—and such a concentration they point out is not possible in any program of water fluoridation.

"If," queries Mr. Herrstrom, "fluorides harden the teeth what is to prevent them from hardening all the bones in the body making them easy to break and too weak to support the body." If the Minnesota editor were as well informed as he would have his readers believe he would know that several studies[2, 3, 4] have been made by excellent authorities which indicate that the concentration of fluorides in the public water supply shows no effect on the incidence of bone fracture.

Neither time nor space nor the patience of the reader permits a listing of the 25 reasons advanced by the Faribault world traveler as to why community water supplies should not be fluoridated, but one of his reasons is so ridiculous that it hardly needs to be challenged. "It is reported," writes Mr. Herrstrom in his September 1951 bulletin which sells for 10 cents, "that in Russia fluorine was added to the milk given babies in order to weaken their wills and make them more amenable to dictatorship when they grew up. This method was used following the revolution in 1917. Is the American public going to be 'doped' into submission to dictatorship here?"

The answer is "no" and neither is the American public going to be "doped" into believing the anti-fluoridation nonsense published for profit by world traveler Herrstrom in his *Americanism Bulletin*.

1. Cox, Charles R., and Ast, David B. Water fluoridation—a sound public health practice. J.A.W.W.A. 43:641 (Aug.) 1951.

2. McClure, F. J. Fluoride domestic waters and systemic effects. I. Relation to bone fracture experience, height and weight of high school boys and young selectees of the Armed Forces of the United States. Pub. Health Rep. 59:1543 (Dec. 1) 1944.

3. Dean, H. T. Testimony given during the hearing on the tolerance for fluoride spray residue on apples and pears held pursuant to the notice issued by the Federal Security Administration May 1, 1944 (9 F.R. 4654).

4. Hodges, P. C., and others. Skeletal sclerosis in chronic sodium fluoride poisoning. J.A.M.A. 117:1938 (Dec. 6) 1941.

Eleventh International Dental Congress
London, England, July 19-26

Slightly more than 60 days remain before the Eleventh International Dental Congress is convened in London, July 19. Dentists here who plan to attend but who have failed to make final travel arrangements are urged to do so at once. Travel agencies report that air and ocean accommodations to Europe this summer are rapidly being exhausted and that even now little preferred space is available.

The July 19 to 26 meeting, the eleventh quinquennial congress organized by the Fédération Dentaire Internationale, bears promise of being the most influential and substantial of any world dental meeting thus far held. The organizing committee, aided generously by the British Dental Association, has extended itself to the limit in order to make this meeting an international success. The principal scientific sessions will be held in the main hall of Britain's Royal Festival building and smaller meetings will be housed in adjacent conference halls. Television, motion pictures, scientific exhibits, and table demonstrations are planned to augment the principal program and conducted tours, balls and banquets will provide members and guests with lighter entertainment.

Breaking away from the orthodox method of presenting a large number of long and highly scientific essays each day the organizing committee has arranged that the international reports on various sections of dentistry, prepared by eminent world authorities, be published in the current year's quarterly issues of the *International Dental Journal*. The preconvention publication of these reports will obviate the necessity of their being read at the Congress, save time, streamline the meeting and permit a more studied discussion of their contents as the main feature of the scientific program. The American delegation will watch with interest this particular innovation. The successful execution of such a plan might lead to its adoption here.

With the passing of the Eleventh International Dental Congress five more years will elapse before another will be held—and five years is a long time. For those who would appreciate an international postgraduate education—limited though it may be; for those who would hear firsthand the opinions of world famous dentists, and for those who would learn of the dental problems of other peoples and the manner of their attempted solution, the Eleventh International Dental Congress, London, July 19-26, promises to fulfill their requirements.

Graduate study: all things to all men

The purpose of graduate work in dental education came in for much animated discussion at the 1952 meeting of the American Association of Dental Schools in Colorado Springs in March. A surprising diversity of opinion among educators was revealed as to the objectives of study leading to advanced degrees in dentistry. Almost every conceivable aim for educating the dentist beyond his undergraduate course was brought forward by one or another of the educators present. And the striking feature of the discussion was that every speaker implied or asserted that only the objective urged by him should motivate a graduate dental program.

In the assembly were those who contended that the schools should train dentists exclusively to practice some specialty such as oral surgery, pedodontics or orthodontics. Proponents of this point of view recommended that clinical experience be given academic credit in order to enhance the skill and knowledge of the prospective specialist.

Others felt that the clinic should be reserved for postgraduate training for which degrees are not awarded.

There were also those present who maintained that the only end of graduate study is pure science. Not only should the advanced dental student confine his labors to the basic sciences, but as several of the proponents of this theory insisted, he should forget dentistry altogether for the time being. This proposition was rebutted by those who declared that the dentist, by divorcing himself from his profession temporarily, might be disposed to confine his interests entirely to so-called pure science and spend the rest of his days in research. To some, such a sequel of graduate work seemed calamitous; others implied that no outcome could be more praiseworthy than converting dentists into research workers. Nobody undertook to explain why a dental school should offer a completely nondental education.

There were also those present who envisioned the graduate program as a principal means of channeling the more gifted young dentists into teaching careers. If the dental graduate could be diverted from the attractive emoluments of professional practice, the harassed administrator of the dental school could thus replenish the dwindling source of instructors for both clinical and basic science subjects. In reply it was pointed out that if the ranks of graduate students were to be kept filled, the graduate work would have to be aimed at the aspirations of the candidate for degree rather than at the teaching needs of the schools.

In the midst of this discord, an auditor who had remained silent rose to propose a way to harmony. When a woman goes shopping to purchase a dress, he said, and she finds two dresses that please her equally well, she is not paralyzed by indecision; she buys both dresses. Many good objectives for dental graduate work may be advanced. It is not necessary to choose among them. A program of graduate study can be planned so as to fulfill any of the legitimate objectives of advanced education and at the same time meet the individual candidate's talents and aspirations.

All of the various and seemingly contradictory purposes which have been suggested for graduate study may be unified in the single requirement that the program should make the student a better dentist—in any path of endeavor into which his professional and academic training may lead him.

The Reader Comments

THE JOURNAL *devotes this section to comment by readers on topics of current interest to dentistry. The editors reserve the right to edit all communications to fit available space and require that all letters be signed. Signatures will be deleted before publication at the request of the author. Printed communications do not necessarily reflect the opinion or official policy of the Association. Your participation in this section is invited.*

The Editor

AN INVITATION

Many American dentists probably will be passing through Glasgow in traveling to or from the International Dental Congress. May I say how delighted I shall be by a visit from all who are interested in the history of our profession. It would afford me considerable pleasure to show them my collection of pre-1850 books, advertisements, prints, dentures, instruments and other items. All are now arranged in cases and comprehensively catalogued.

Further, it would prove a great stimulus to discuss various points with those imbued with similar interests; one can learn much from an interchange of views.

My telephone number in Glasgow, Western 2640.

J. Menzies Campbell, D.D.S.,
14, Buckingham Terrace, Glasgow, W. 2, Scotland

FLUORIDES IN TABLE SALT

To the Editor.—Would it not be less wasteful to put fluorine in minute amounts in our table salt, as has been done with iodine, than to put it in the water supply? Such a small quantity of the water in the mains ever reaches a person's digestive tract, but most of the salt in salt shakers eventually does.

Z. F. Endress, M.D., Pontiac, Mich.

Answer.—Caries inhibition by fluoride (about 1 ppm of fluorine) in drinking water has been studied in great detail. No comparable information is available for judging the effect of fluoride added to table salt. The known variations in the consumption of salt by different persons suggests that the latter procedure would not be satisfactory. Furthermore, many drinking waters naturally contain adequate fluoride, and the use of a fluoridized salt would be undesirable in these cases. It is more logical to add iodine to salt, because iodides have a much wider margin of safety than do fluorides. The wastefulness of adding fluoride to a water supply is more apparent than real. The added materials are readily available and inexpensive, and also the labor involved in a carefully controlled program is negligible when computed in terms of the individual child.

Taken from "Queries and Minor Notes." J.A.M.A. 148:87 (Jan. 5) 1952.

THE CASE AGAINST INCLUDING DENTISTS IN SOCIAL SECURITY

On March 3, 1952 the French franc fell to a new low of 483 to the United States dollar.[1] This means that you can get five francs for one cent. In 1914 the exchange rate was five francs for one dollar. French money is worth one one-hundredth of what it once was.

Suppose a French dentist who was 27 years old had started Social Security payments in 1914. Today he would be 65 and eligible to receive 100 francs each month for the rest of his life. Do you know what he could buy for that 100 francs? As of March 10, 1952 he could buy two loaves of bread.

France is a country roughly 27 per cent as big as our own, and what happened there might not happen here. Or could it? Since 1939 our dollar has shrunk at the rate of five cents per year and is now worth about 40 cents. At this rate, it will be worthless in another eight years.

Is there any reason to assume that inflation will stop soon, and that the value of the dollar will rise? No. All of the factors that caused this inflation are still with us. Two of these factors are:

1. We are not on the gold standard. Ours is a managed currency. This means that the value of the dollar to a large degree depends on the whims of the Government and not on the rise and fall of trade, as in former times.

2. We engage in wars, which are always inflationary. History shows that the average American sees his country involved in three wars during his lifetime. The younger dentist will undoubtedly see his savings devalued by the effects of a future war involving this country.

Inflation is very real. It is possible, almost certain, that what happened to our mythical French dentist will happen to contemporary dentists.

Even if the inflation threat is minimized or is a risk that the dentist is willing to take, his inclusion in the Social Security program is not to his best advantage because of its compulsory features. Once you are a contributor to Social Security you cannot get out. You pay until the day you stop working or die. The Government can change the rates, benefits or terms at its will, and you can do nothing about it. If the program does not suit you, it makes no difference; you cannot withdraw.

Since dentists do not have regular incomes or unemployment insurance, they should avoid programs that require fixed payments for a great many years or for life. The Social Security program is a life term, and payments would be a hardship on many dentists. At present they are a hardship on four times as many people as last year. A nationwide check of loan companies and banks made on March 14, 1952 showed that four times as many people are borrowing to pay their income tax this year as in 1951.

Vote against including dentists in the Social Security program.

J. Cameron McDade, D.D.S., Philadelphia

1. All quotes using specific dates are from the Wall Street Journal of that day.

CAUSE AND EFFECT IN TRAUMATIZED TOOTH CASE

I would like to comment on the case report "Nodular Calcification in an Eleven Year Old Boy" which appeared in the March 1952 issue of THE JOURNAL.

Traumatic injuries of the teeth, when no root fracture has occurred, follow patterns of pathology which depend upon the extent of damage to the vessels at the apical foramen. Since there is no collateral blood supply to the pulp in this type of injury, degenerate changes develop there, such as reticular atrophy, fibrosis, fatty and calcific degeneration, or necrosis and gangrene.

Presence of calcific deposits (pulp nodules), is a response to a sluggish inadequate circulation along with the deposition of calcium salts. But this process is not responsible for strangulation of the vascular supply. The strangulation occurs at the apical foramen at the time of the initial injury. Degenerate and infectious changes are the sequelae.

In summary, if this condition can be regarded as a cause and effect relationship, then the injury to the vessels at the apical foramen is the cause of their strangulation and the effect may be calcific degeneration (pulp nodules) with subsequent necrosis.

I hope the above explanation may yield a clearer picture of the basic underlying pathology involved when a tooth has been traumatized.

Martin S. Protzel, Newark, N. J.

Washington News Letter

This month of May will witness a powerful effort to achieve, in effect, a Senate veto of previous action by the House of Representatives. Earlier this spring, the House drastically reduced appropriations for veterans' dental services. Inasmuch as 59,000 dentists are participating in the Veterans Administration's outpatient care program and thousands more are involved as consultants, part-time research workers or full-time VA dental practitioners, it is obvious that this budgetary issue is one of great magnitude.

Late in March, the House passed an appropriations bill that slashed 10 per cent from the $40,445,500 which President Truman had requested for payment of dental and medical fees during the fiscal year beginning July 1, 1952. A $23,500,000 cut (about 40 per cent) was made in the item for contractual services, which includes compensation to dental and medical consultants, reimbursement to teaching institutions for services rendered and payments for care of beneficiaries in non-federal hospitals and homes. The medical-dental research budget was sliced in half, to $2,750,000.

Although dental activities account for relatively small percentages of the appropriations for contractual services and research, they comprise approximately 70 per cent of the outpatient care program. Unless the fund reduction in the latter category is restored, there will have to be a retrenchment eliminating 779,000 fee-basis dental treatments and 41,300 dental examinations in 1952-53, according to estimates by Veterans Administrator Carl R. Gray, Jr. All this, he added, in the face of increasing work loads resulting from Congressional enactment since 1950, of legislation liberalizing eligibility for VA-covered dental care.

General Gray disputed claims made by certain House members that fee schedules are exorbitant and should be reduced in order to keep the backlog to a minimum. "The fees," he said, "are based on contracts with state and local medical and dental societies and are materially less than average fees charged. Where no contract exists, fees are based on existing VA fee schedules which are considered to be reasonable but not excessive."

The American Legion is in the vanguard of non-governmental organizations striving for restoration of the funds cut out by the House. Its representatives will appear before a Senate subcommittee some time in May to appeal for favorable action. Chairman of the appropriations subcommittee is Senator Maybank (D., S. C.) and other members are Senators O'Mahoney (D., Wyo.), McKellar (D., Tenn.), Hill (D., Ala.), Ellender (D., La.), Robertson (D., Va.), Saltonstall (R., Mass.), Bridges (R., N. H.), Ferguson (R., Mich.), Gordon (R., Ore.) and Thye (R., Minn.).

The disproportionately small amount of financial support allocated to dental research in the United States is demonstrated convincingly in a comprehensive report published recently by the Medical Sciences Information Exchange of the National Research Council. Its study comprised an analysis of 12,923 research grants—both governmental and private—awarded during the period 1946-51. Their dollar value aggregated $135,044,125. Of this total, 61.5 per cent came from government sources.

For investigation of dental problems, support came to only $1,090,653, or 0.81 per cent of the total. Federal grants accounted for 89 per cent of the amount. By contrast, urogenital research received $1,191,170; endocrine, $3,056,095; blood, $3,534,811, and musculoskeletal system, $3,226,545. Top research projects were cancer, $26,389,761; infectious diseases, $23,881,831; cardiovascular, $11,832,433, and basic studies, $4,769,150.

From its Washington headquarters, the National Boxing Association has announced its appointment of an advisory committee that will conduct a continuing study of oral and maxillofacial injuries occurring in the prize ring, and their prevention. Members of the group, all dentists, are Leslie C. Simkins of Seattle; B. W. West of Huntington, W. Va.; Vincent J. Oddo, Jr., of Providence, R. I., and Comdr. J. V. Niiranen of the Navy Dental Corps. The latter is co-inventor of an all-purpose sports mouthpiece whose development was announced a few months ago by the Naval Medical Center, Bethesda, Md., to which Cmdr. Niiranen is attached.

Brig. Gen. Louis H. Renfrow, Deputy Director of the Selective Service System, gave a review of military dental accomplishments in an address delivered April 15 before the Wisconsin State Dental Society at its 82nd annual meeting in Milwaukee. As an example of services performed by 26,000 Army (including Air Force) and Navy dentists during World War II, General Renfrow presented the following statistics: Permanent fillings,

104,000,000; dentures, more than 3,100,000; extractions, examinations and miscellaneous treatments, more than 47,000,000.

"This reflects most favorably on the civilian practice of every dentist because it engenders appreciation of good dentistry on the part of the military patient," he stated. "This fine professional service causes these military patients to urge their dependents to seek more and better dental care, and the increase in the numbers of patients in private dental offices today is the direct result of the splendid dental treatment that service men and women received while on active military duty."

Current authorized strength of the Armed Forces will require about 6,500 dental officers, said General Renfrow, adding that still more will be needed to replace those completing periods of obligated duty. In the matter of procurement, he observed that dental registrants placed in Priority I and Priority II by Selective Service have applied for commissions in the Dental Corps of the services in sufficient numbers to meet requirements.

In this regard, early in April Selective Service headquarters advised all state directors to review cases of Priority I dentists who have been placed in deferred-for-essentiality status (2-A). As many of them as possible should be reclassified and placed in 1-A, the state directors were told, inasmuch as the Priority I pool is now virtually exhausted and it is becoming necessary to dip into Priority II to fulfill dental manpower needs.

A slight measure of relief is expected to be provided by Congressional passage of a law authorizing the commissioning of women in the Army, Navy and Air Force Dental Corps on equal basis with men. The enabling bill (S 2552) passed the Senate several weeks ago and has been favorably acted upon by the House Armed Services Committee. Another factor in the military dental personnel picture is the decision which Congress must make soon on continuing or abolishing the $100 extra monthly pay received by medical and dental officers. The matter is still in the committee hearing stage.

International Correspondence

NEWS FROM NORWAY

The use of fluorine in caries prophylaxis is, of course, the center of interest here in Norway, as well as elsewhere.

Topical application of two per cent sodium fluoride has been carried out both in scientific investigations and as a mass control. In recent studies at the Institute of Dental Research, Syrrist checked a group of school children treated with sodium fluoride more than four years ago, and the results will be published in the near future.

At the school dental clinics of Oslo, a mass treatment with sodium fluoride is carried out as a routine work by the dental hygienists and dental assistants. The work was originated and is supervised by the director, Dr. Ramm, according to the method of Dr. Knutsen.

As regards the fluoridation of drinking water, this has been discussed by the Public Health Service and the Institute of Dental Research. It was also an item of discussion at the last meeting of the Norwegian Dental Association. So far nothing has been done in this matter as the problem is more complicated here. For one thing, the water intake by the population in Scandinavia is considerably less than that in the United States. It is illuminating to note that in a part of Denmark it was found that the water contained more than 2.5 ppm fluorine, and yet no trace of mottled enamel could be recorded.

The Institute of Dental Research seems to have an experimental field for investigations of this kind without any effort. In the western part of Norway, the smoke from a big aluminum factory fluoridates the drinking water of an isolated population group. A method of neutralizing the smoke, which until now has poisoned the flora, and consequently the livestock, seems to bring the fluorine content of the water up to significant values. Analyses of the water near the factory show 1.3 ppm of fluoride at the present.

In the question of water fluoridation it has been decided here to play a waiting game: close observation of the great experiments going on in the United States, charting of the natural fluorine content of the drinking water in various parts of Norway, and investigations in districts where such fluoridation is achieved by the aluminum industry.

Knut Gard, Oslo, Norway

ANNUAL SPRING MEETING OF THE ASSOCIATION'S BOARD OF TRUSTEES

Approval of a new health and accident group policy for Association members and a statement of suggestions for a labor union dental program were among the actions taken by the Board of Trustees of the American Dental Association at its annual spring meeting March 27-29 in the Central Office.

HEALTH AND ACCIDENT INSURANCE

A "professional disability" group policy of health and accident insurance was approved by the Board of Trustees, and will be made available to members of the Association on September 1.

The new policy defines total disability as "the inability to practice dentistry" because of accident or illness. Totally disabled policy-holders will receive monthly benefits up to $400 for as long as 60 months following an accident and 24 months during illness. Policy holders who are partially disabled in an accident will receive one-half of the monthly benefit for periods up to six months.

Premium rates will vary according to age and extent of coverage.

Dentists under 65 years of age are eligible for this insurance if they are actively engaged in the full-time duties of their profession on the date their insurance is to become effective. Although age limit for acceptance is 65, once a policy-holder is accepted, his policy cannot be terminated because of age. Nor can an individual's policy be terminated because of recurrent disability.

The group policy will not become effective until one-half of the Association's members subscribe. However, 10,000 members of dental societies in California, Utah, New Jersey and New York have already enrolled in this policy under individual state plans and they will be credited toward the membership required to put the Association's policy into effect.

The new insurance program is designed to supplement the group insurance programs now carried by many state dental societies, and to provide a group plan for members of constituent and component societies which do not have an insurance program. The policy is offered in conformity with a survey of members' wishes in matters of insurance.

Paul Zillman of Buffalo, chairman of the Council on Insurance, has been appointed trustee for the group policy. The National Casualty Company of Detroit will be the underwriter and M. A. Gesner Company of New York, the broker of record.

Further details will be presented in a report of the Council on Insurance, to be published in a later issue of THE JOURNAL.

LIBERALIZED LIFE INSURANCE

The Board approved a proposal of the Great West Life Assurance Company to provide greater coverage under the Association's present group life insurance program. For members who elect the increased benefits, the principal sum of insurance will be raised from $3,450 to $5,000 with double indemnity coverage, and a $400 paid-up insurance policy will be presented to insured members attaining the age of 76. The last provision will continue for five years, when there will be a review by both parties to the agreement. The new benefits will increase rates $3-$16.60 annually, effective July 1.

This life insurance program is not related to the new health and accident insurance policy.

UNION DENTAL SERVICE PROGRAM

After reviewing the dental program of the United Mine Workers of America Welfare and Retirement Fund, the Board directed the Secretary of the American Dental Association to confer with Fund administrators on dental services to Fund beneficiaries.

In response to the request of the Fund's medical director, the Board of Trustees also transmitted a statement containing specific suggestions on improving the union's present dental program. The statement urged cooperation between Fund administrators and state and local dental societies. It also advised the use of dentists exclusively in dental service and diagnosis of the dental needs of beneficiaries, counseling the employment of dentists "who observe common standards of professional ethics."

VA DENTAL SERVICE

The board requested officials of the Veterans Administration to continue the office of Assistant Chief Medical Director for Dental Service, "to the end that the improvements initiated in the dental program of the Veterans Administration may be carried to a successful completion." The Board also commended the present dental service for its "ability and sound leadership in espousing equitable administration for the dental program."

COUNCIL APPOINTMENTS

Maynard K. Hine, dean of the Indiana University dental school and member of the Council on Dental Research, was appointed to the chairmanship of the Council by the Board of Trustees, to succeed J. L. T. Appleton, who has resigned.

Lawrence E. Van Kirk, dean of the University of Pittsburgh dental school, was appointed by President LeRoy M. Ennis to fill the vacancy on the Council. This is an *ad interim* appointment; a permanent appointment will be made by the House of Delegates at the 1952 annual meeting.

The Board also approved the appointment of B. O. A. Thomas of Seattle, as consultant to the Council on Dental Museum and Registry.

ASSOCIATION'S ACCREDITING PROGRAM

Representatives of the Council on Dental Education advised the Board of Trustees that all educational accrediting agencies are now under investigation by a commission that is studying the standards and practices of such agencies. It was pointed out that the commission, which represents certain college and university administrators, has requested all of the accrediting agencies of the professions to discontinue temporarily their accrediting activities.

The Board approved the Council's stand that the Association's accrediting program must not be interrupted. The accrediting program of the Council on Dental Education has the support of the American Association of Dental Examiners, the American Association of Dental Schools and the American Dental Hygienists' Association. The A.A.D.S. took official action on this matter at its recent meeting in Colorado Springs.

JOURNAL OF ORAL SURGERY

Frederick A. Henny of Detroit was appointed to a three-year term as editor of the JOURNAL OF ORAL SURGERY, replacing Reed O. Dingman, who had resigned. Dr. Henny is associate surgeon in the division of oral surgery at Henry Ford Hospital, Detroit. Dr. Dingman was appointed an associate editor of the publication. (See page 576.)

DISCLAIMER ON REPRINTS

The Board directed that a disclaimer be placed on all reprints of material appearing in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION and the JOURNAL OF ORAL SURGERY, with the exception of materials authorized by Councils, committees and Bureaus of the Association. The disclaimer states that expressions of opinion or other statements "are not to be regarded as expressing the views of the American Dental Association unless such statements have been adopted by the Association."

OBJECTIONABLE ADVERTISING

After discussing several complaints regarding objectionable advertising by dental laboratories in national publications, the Board requested the Council on Legislation to prepare a statement on the statutory means by which the various states may curb or control undesirable types of advertising. The statement is to be prepared for publication in an early issue of THE JOURNAL.

The Board also approved more stringent standards suggested by the Council on Dental Therapeutics for labeling chemicals proposed for disinfection of instruments.

1952 ANNUAL SESSION

Membership of the Committee on Local Arrangements for the 1952 annual session, September 8-11 in St. Louis, was approved by the Board as follows:

Chairman, Henry F. Westhoff; vice chairmen, David W. Brock, Max Kornfeld, Romie H. Miller and O. F. Steber; honorary chairmen, Oren A. Oliver, Robert P. Thomas, Roy J. Rinehart, Otto J. Fruth and H. C. Pollock.

Reception Committee • Frank A. Strake, chairman; Arthur F. Schopper, Lee Roy Main, Russell C. Wheeler, Edgar H. Keys, Ruth Martin, Leo M. Shanley, J. Floyd Alcorn, John M. Clayton and Bates Hamilton.

Subcommittee on Information • George A. Clipner, chairman, Joseph V. Kirby, H. S. Ghio, Raymond F. Pohle, Edward J. Hunter, James R. O'Neal, Robert C. Byrne, Kenneth Lietz, Raymond L. Davenport and Donald J. Wolken.

Subcommittee on Entertainment • P. G. Vierheller, chairman, Earl J. Poe, Sidney T. Williams, Earl E. Shepard, Paul A. Ebeling, Roger J. Wellman, Victor P. Thompson, Gordon P. Fisher, Ryland M. Ayres and Nimon A. Slane.

Subcommittee on Publicity • Alva N. Blaney, chairman, Ralph Rosen, vice-chairman, Robert M. Courtney, Robert E. Kenny, Ted W. Key, Joseph M. Lundergan, Hugh E. O'Keeffe, John J. Purcell, Roy M. Wolff and Herbert W. Zahner.

Subcommittee on Convention Hall • Frank W. Jaeger, chairman, John M. Marre, Ray Pohle, Edward Rehm, Edward Signaigo, Harold Rinesmith, Jack Dann, Sam Pagano, James Hickey, Frank Cushing, Francis Hayden and Robert E. Bedell.

Subcommittee on Women's Entertainment • Mrs. Earl C. Bean, chairman, Mrs. Earl E. Shepard, Mrs. Albert C. Mogler, Mrs. Otto A. Walter, Mrs. J. M. Lundergan, Mrs. Lester H. Jasper, Mrs. Leo B. Lundergan, Mrs. Alva N. Blaney, Mrs. Robert M. Courtney and Mrs. Henry F. Westhoff.

SECTION CHAIRMEN FOR 1953

The following section chairmen for the 1953 annual session were approved by the Board, after receipt of their nomination from the Council on Scientific Session:

Operative Dentistry: Miles R. Markley, Denver
Oral Surgery and Anesthesia: Irwin T. Hyatt, Atlanta, Ga.
Orthodontics and Oral Development: Robert M. Ricketts, Chicago
Pedodontics: Harold K. Addleston, New York
Periodontics: Rowe Smith, Texarkana, Ark.
Practice Management: Ralph H. Campbell, Detroit
Prosthodontics, Complete Dentures: Frank M. Kyes, Bethesda, Md.
Prosthodontics, Partial Dentures: Oliver C. Applegate, Ann Arbor, Mich.
Public Health Dentistry: Milton E. Nicholson, Pittsburgh

Research: H. B. G. Robinson, Columbus, Ohio
Roentgenology: H. Cline Fixott, Jr., Portland, Ore.

LEGISLATIVE ADVISORY SERVICE

The following members of the Association, to be designated as the Advisory Service to the Council on Legislation, were approved for terms ending with the 1952 annual meeting:

Alabama: J. L. Hughes, Albertville
Arizona: W. J. Johnson, Phoenix
Arkansas: H. S. Neel, Stuttgart
California State: C. F. Gray, Sacramento
California, Southern: C. Stanley Rice, Beverly Hills
Colorado: J. M. Peabody, Denver
Connecticut: H. T. Quinn, Greenwich
Delaware: C. R. Cannon, Georgetown
District of Columbia: Z. B. Lloyd, Washington
Florida: R. D. Cummins, St. Petersburg
Georgia: J. R. Tucker, Atlanta
Hawaii: W. K. Holt, Honolulu
Idaho: Hugh Colver, Boise
Illinois: J. W. Green, Springfield
Indiana: E. A. W. Montgomery, Evansville
Iowa: F. B. Whinery, Iowa City
Kansas: N. O. Feeley, Topeka
Kentucky: E. A. Willis, Owensboro
Louisiana: C. A. McHardy, Baton Rouge
Maine: A. W. Easton, Norway
Maryland: J. P. Barker, Laurel
Massachusetts: R. A. Barrette, Newton
Michigan: C. H. Matson, Flint
Minnesota: Charles Blumer, Minneapolis
Mississippi: J. C. Boswell, Jackson
Missouri: E. D. Suggett, Jefferson City
Montana: C. H. Swanson, Columbus
Nebraska: L. D. Arnot, Lincoln
Nevada: H. E. Cafferata, Reno
New Hampshire: H. F. Besse, Concord
New Jersey: E. R. Westcott, Atlantic City
New Mexico: M. V. Berardinelli, Santa Fe
New York: E. O. Bush, Walton
North Carolina: Vacancy
North Dakota: A. O. Schjeldahl, Valley City
Ohio: R. L. Cummins, Columbus
Oklahoma: O. R. Whiteneck, Enid
Pennsylvania: E. H. Albert, Harrisburg
Oregon: K. K. Adams, Salem
Rhode Island: M. B. Messore, Providence
South Carolina: E. F. Mickle, Columbia
South Dakota: C. H. Boyden, Mitchell
Tennessee: J. J. Vaughn, Sr., Nashville
Texas: E. E. Harris, Austin
Utah: W. C. Haymond, Salt Lake City
Vermont: C. I. Taggart, Burlington
Virginia: W. H. Street, Richmond
Washington: D. R. Shaw, Tacoma
West Virginia: L. D. Cleek, Charleston
Wisconsin: E. C. Wetzel, Milwaukee

OTHER ACTIONS BY THE BOARD

Relief Fund • The Council on Relief was authorized to print an informational brochure, to be used in connection with the next relief drive. The name of the annual relief campaign was changed to Annual Relief Fund Campaign, from Annual Relief Seal Campaign.

National Midcentury Committee • The Board denied a request for a grant from the National Midcentury Committee for Children and Youth, Inc. The request was denied "until appropriate representation is granted to the dental profession" in the organization of the committee.

Commission on Chronic Illness • An appeal was addressed to the Commission on Chronic Illness to give greater attention to the dental needs of chronically ill persons, especially those who are bedridden. The Board also requested the Commission to appoint a dentist to its policy-making body and to add dental societies and dental schools to the mailing list of its *News Letter*.

Post-Training Dental Benefits • The Board approved the Association's recommendation to the National Security Training Commission regarding post-training dental benefits under a universal military training program. The recommendation states that dental treatment should be given only if the dental condition was not present at the time of entry into military service, but occurred during the period of service and was not treated or completely corrected during that time.

The following officers attended the session: LeRoy M. Ennis of Philadelphia, president of the Association; Otto W. Brandhorst of St. Louis, president-elect;

David J. Fitzgibbon of Washington, D. C., first vice-president; P. M. Cunningham of Cheyenne, Wyo., second vice-president; Brig. Gen. Oscar P. Snyder, third vice-president; Harold Hillenbrand of Chicago, secretary; C. Willard Camalier of Washington, D. C., and Louis M. Cruttenden of Chicago, assistant secretaries; H. B. Washburn of St. Paul, treasurer, and Lon W. Morrey of Chicago, editor.

Ernest G. Sloman of San Francisco, speaker of the House of Delegates, was unable to attend because of illness.

Trustees present at the meeting included: William R. Alstadt of Little Rock, Ark., twelfth district; J. B. Carr of Indianapolis, seventh district; W. Earle Craig of Pittsburgh, third district; C. S. Foster of Cedar Rapids, Iowa, tenth district; L. H. Jacob of Peoria, Ill., eighth district; James E. John of Roanoke, Va., fifth district; Bernerd C. Kingsbury of San Francisco, thirteenth district; Daniel F. Lynch of Washington, D. C., fourth district; Obed H. Moen of Watertown, Wis., ninth district; Percy T. Phillips of New York, second district; Clarence S. Renouard of Butte, Mont., eleventh district, and Robert P. Thomas of Louisville, Ky., sixth district.

Charles I. Taggart of Burlington, Va., trustee from the first district, was unable to attend because of illness in his family.

The Board voted to convene its next meeting on September 1, 1952.

JOURNALISM WORKSHOP TO MEET JUNE 18-19

Topics ranging from the use of art in a dental journal to the finances involved in production will be discussed at the annual Editorial Conference, June 18-19, at the Central Office. Sponsored jointly by the Council on Journalism of the Association and the American Association of Dental Editors, the meeting will attempt to solve the problems encountered in publishing state dental periodicals.

Featured speakers will include the representative of a printing company, a national advertiser, an artist and designer and an editorial consultant. They will deal with composition of dental publications, methods of improving style and appearance of a publication, advertising rates and advertising promotional methods.

Dorothea F. Radusch, president of the American Association of Dental Editors, and Charles A. Wilkie, chairman of the Council on Journalism, will also address the conference.

25,000 DENTISTS TO GET SURVEY QUESTIONNAIRES

Questionnaires will be sent to 25,000 selected dentists in the next few weeks, in the opening phase of the Association's nation-wide survey of current dental needs.

The 25,000 dentists chosen to participate in the survey will be asked to report on the dental needs of 10 consecutive patients, noting fillings, dentures, extractions and other dental treatment. All dentists participating will gather this information on a specific day this month.

The survey will be conducted by the Association's Bureau of Economic Research and Statistics, under the direction of B. Duane Moen. It is expected to show whether dental needs are greater or less than they were in 1940, when a similar survey was conducted. It is designed to be helpful particularly to agencies engaged in developing practical dental health programs.

"The success of the survey depends on the cooperation of all dentists receiving questionnaires," Mr. Moen stated recently in an appeal for the cooperation of all dentists who are selected to participate. "Dentists will be making a significant contribution to knowledge of national dental needs by filling out the reports completely and carefully.

"Within recent years new methods of controlling dental caries have been developed, and dental health education has received increased emphasis. A measurement of dental needs now will provide a basis in future years for determining the extent to which these caries-control methods have combined to reduce the prevalence of dental needs."

F. A. HENNY NAMED EDITOR OF *JOURNAL OF ORAL SURGERY*

Frederick A. Henny of Detroit, associate surgeon in the Division of Oral Surgery, Henry Ford Hospital, has accepted the editorship of the *Journal of Oral Surgery*.

F. A. Henny

Dr. Henny, an associate editor of the publication for the past three years, has written extensively on oral surgery. A graduate of the University of Michigan School of Dentistry in 1935, Dr. Henny was an intern and resident in oral surgery at the Henry Ford Hospital from 1935 until 1938, when he was appointed associate surgeon in the hospital's Division of Oral Surgery. He is a diplomate of the American Board of Oral Surgery and a member of Omicron Kappa Upsilon, the Chalmers J. Lyons Academy of Oral Surgery, American Society of Oral Surgeons, Great Lakes Society of Oral Surgeons and the American Dental Association.

Dr. Henny replaces Reed O. Dingman of Ann Arbor, Mich., who resigned the editorship as of April 1. Dr. Dingman has accepted an appointment as an associate editor of the publication.

ASSOCIATION REPRESENTED IN HEALTH COUNCILS

Kenneth A. Easlick of Ann Arbor and Harold Hillenbrand of Chicago represented the American Dental Association at the recent meeting of the Inter-Association Committee on Health, at the offices of the First District Dental Society, New York.

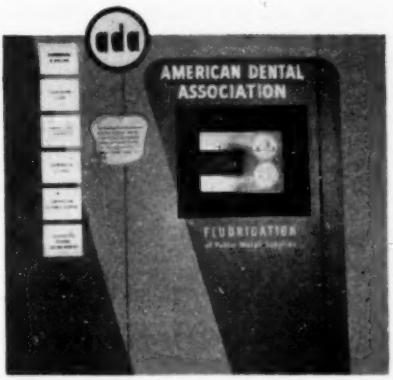
Dr. Hillenbrand, secretary of the Association, was re-elected recently to the Board of Directors of the National Health Council for a term ending in March, 1955.

ASSOCIATION PREPARED TO TESTIFY ON PENSION BILL

The House Ways and Means Committee has announced that it will hold hearings on the Reed-Keogh bill during this session of the 82nd Congress. The committee, however, did not set a definite date for the hearings. The Association has been assured of an opportunity to testify, and will support the proposal at that time.

The bill would permit persons, especially the self-employed, to finance their own pension programs by permitting them to deduct from their taxable incomes contributions to a pension fund sponsored by an authorized organization. Dental associations and societies would be authorized to sponsor retirement programs for their members.

If the bill becomes law a dentist could deduct from his taxable income each year as much as $7,500 or 10 per cent of that income, whichever is less, if he contributed that sum to the pension fund. He would be obligated to report as income the payments received from the fund which would begin at age 60.



When members of the dental profession from all parts of the world meet in London July 19-26 for the eleventh International Dental Congress, they will see this exhibit on fluoridation in the United States, prepared by the Council on Dental Health. Entitled "Fluoridation of Public Water Supplies," the 10 foot wide exhibit uses 30 slides to tell a four-minute story of what fluoridation is, how it operates and what it is expected to accomplish. Lighted transparencies on the left list the outstanding features of fluoridation.

At the close of the Congress, the exhibit will be available for display in this country along with other Association exhibits.

2,000 REGISTER EARLY FOR 93rd ANNUAL SESSION

A total of 2,000 persons who plan to attend the ninety-third annual meeting of the American Dental Association have been assigned hotel rooms in St. Louis, it was announced April 15 by the Association's Housing Bureau.

In terms of available rooms, nearly one-third of the 3,868 rooms committed to the Association have now been assigned. Persons wishing to attend the annual session have been requested to fill out the housing application which appears on page A-31 of this issue.

Dental groups which will meet in conjunction with the annual meeting of the Association are as follows: American Academy of Periodontology, American Association of Dental Editors, American Association of Dental Examiners, American Association of Dental Schools, American Association of Public Health Dentists, American College of Dentists, American Dental Assistants Association, American Dental Hygienists Association, American Denture Society, American Society of Dentistry for Children, Association of American Women Dentists, International College of Dentists, National Association of Seventh-Day Adventist Dentists, Alpha Omega, Delta Sigma Delta, Psi Omega and Xi Psi Phi.

DENTAL HEALTH COMIC BOOK AVAILABLE FOR DISTRIBUTION

"Daredevil Davey Conquers Space," or "In One Era and Out the Other" is the latest educational comic book published by the Council on Dental Health for distribution to children of school age. Information on nutrition and dental care is incorporated into a story of the imaginative Davey, popular hero of the series. Prices, as shown in the Catalog of Education Materials, are $2.85 for 25 copies, $5.15 for 50 and $8.85 for 100. Orders may be addressed to the Order Department, 222 East Superior Street, Chicago 11.

PUBLIC HEALTH DENTISTRY TOPIC OF CONFERENCE

A conference on public health dentistry was to convene April 28 in the Central Office, in connection with the next meeting of the Council on Dental Health, April 27-29.

Participants in the conference were to include John W. Knutson, chief of the Division of Dental Public Health, U. S. Public Health Service; Philip E. Blackerby, director of the division of dentistry, W. K. Kellogg Foundation; William A. Jordan, director of the division of dental

health, Minnesota Department of Health; Dr. Carl Sebelius, director of dental hygiene service, Tennessee Department of Public Health; James F. Lewis, regional dental director and consultant, U. S. Public Health Service, and John E. Chrietzberg, deputy director of the division of dental health, Illinois Department of Public Health.

SODIUM FLUORIDE TABLETS RATED "INCONCLUSIVE"

Sodium fluoride tablets to be dispensed by prescription for use in drinking water have been placed in Group C—"products (which) require further study by qualified investigators"—by the Council on Dental Therapeutics. At its meeting April 4-5 in the Central Office, the Council also voted to place all other fluoride tablets in the category of "unacceptable" products.

The Council reaffirmed its position of recommending fluoridation as a safe and effective health measure after reexamining reports on controlled studies.

L. W. Burket of Philadelphia was reelected vice-chairman of the Council during the meeting. All members attended, including Thomas Hill, chairman, Clark Chamberlain, Philip Jay, Theodore Kaletsky, Paul Kitchin, Harry Lyons, F. D. Ostrander and Floyd Paynter.

National Defense

RESERVE BEGINS RECALL OF DENTISTS WHO SERVED

Twenty-five dentists from the Army Reserve will be ordered into active service in July, it has been announced by the Department of Defense. For the first time, the Army Dental Corps will call back dentists who have served more than 90 days. These reserve officers correspond in length of service to Priority II registrants under the Selective Service System.

ORDER REVIEW OF DEFERMENTS FOR PRIORITY I DENTISTS

"All Priority I dentists who have been classified in Class II-A (essential) should be reviewed at once and as many as possible made available before the impending call for Priority II dentists."

This directive to state draft headquarters was issued April 7 by the National Advisory Committee of the Selective Service System, as the induction of Priority I dentists virtually exhausted the pool of dentists who have not served in the Armed Forces.

In its directive, the National Advisory Committee noted the recent statement of Melvin A. Casberg, chairman of the Armed Forces Medical Policy Council, which reiterates the sequence of call: ". . . the Selective Service System will be requested to bring the remaining Priority I registrants into service before any Priority II type reserves are called up."

Priority II dentists, who may be inducted into the Armed Forces "in the near future," will be called up on the basis of their length of active duty with the military services or the U. S. Public Health Service.

Priority II registrants include dentists who participated as students in service training programs during World War II and those who were deferred from service to attend dental school, and who—unlike Priority I registrants—served more than 90 days but less than 21 months in the armed services.

BONUS PAY FOR DENTISTS IN ARMED FORCES DEBATED

J. Claude Earnest of Monroe, La., a member of the Council on Legislation, appeared before the Preparedness Subcommittee of the Senate Armed Services Committee on April 17, to list the reasons why the government should continue the $100 monthly bonus to dental officers in the federal military and public health services.

Speaking for the American Dental Association, Dr. Earnest opposed the threatened discontinuance of the bonus as proposed by Sen. Paul Douglas (D., Ill.). To discontinue these payments, he stated, would in effect breach the contract which the government has made with both regular and reserve officers now entitled to the bonus pay.

Dr. Earnest also urged the extension of bonus pay eligibility beyond the September 1, 1952, deadline so that dentists who enter service after that date will be eligible for the bonus pay.

Under the present law a dentist who accepts a commission in the regular service after September 1, 1952, will not be entitled to the $100 monthly bonus pay. Whether a reserve dental officer recalled to active duty after September 1 will be entitled to the bonus pay has not been determined officially.

In his request for the continuance of the bonus pay beyond September 1, Dr. Earnest asserted that the basic reasons for enacting the bonus legislation in 1947 are applicable today: income from private practice is attractive; the military demand for dentists continues, and there is still a shortage of personnel in the regular dental corps.

Representatives of the American Medical Association and the Department of Defense also testified in support of continuing the bonus payments. Senator Douglas testified in support of his proposal to eliminate the bonus payment program entirely.

RESERVE OFFICERS ADVISED TO CHECK INDUCTION STATUS

The Secretary of the Council on Legislation has issued the following statement for the information of dentists who are members of Reserve Corps:

Within the next two months all special registrants in Priority I will have been deferred or will have been inducted into one of the Armed Forces. Thereafter calls will go out for Priority II special registrants.

When the special registrants in Priority II begin to accept commissions, they will pave the way for the first call-up of reserve officers not registered under Public Law 779. There are about 1,100 Naval Reserve dentists who received their training under V-12 and who thereafter had some months or years of active military service. There is likewise a small group of Army Reserve officers who received their dental training under ASTP.

Under a directive of Secretary of De-

Maj. Gen. Walter D. Love, chief of the Dental Division of the Army Surgeon General's Office (right), is shown talking with Sgt. William Bonilla (left) during an inspection of the shipping and receiving department of a medical depot in Korea. General Love recently toured all Eighth Army dental installations in the Far East Command.

fense Johnson dated September 7, 1950, which is being revised, medical and dental reserve officers were divided into three classes for purposes of being ordered to active duty. These were (a) former ASTP and V-12 students who had not World War II or subsequent duty; (b) former ASTP and V-12 students who had some subsequent military service (Group (b) was to be called according to inverse length of previous service); (c) all others.

Priority II special registrants who accept commissions in preference to induction immediately fall into class (b). Reservists who fall into class (b) will begin to receive orders at the same time as those who are now being commissioned from Priority II.

Apparently the armed services, between now and July 1, 1953, will need about 4,000 new dental officers to meet expansion and replacement programs. Reserve officers should examine their own positions without delay in order to make intelligent advance plans to meet a possible call for service within the next year.

Dental Education

ACTING DEAN OF N.Y.U. DENTAL SCHOOL APPOINTED

Claus F. Hinck, Jr., has been appointed acting dean of the New York University College of Dentistry, succeeding the late Walter H. Wright. Dr. Hinck, a professor of biochemistry, is not a dentist but has served as a full professor in the dental school for 27 years. He earned his doctorate in chemistry at the University of Heidelberg in Germany and joined the University faculty in 1914. He is known for his research studies in dental chemistry.

A.A.D.S. OPPOSES INCENTIVE GRANTS FOR EDUCATION

At its recent meeting in Colorado Springs, the American Association of Dental Schools approved the principle of federal aid to dental schools, but vigorously opposed incentive grants aimed at inducing schools to attempt greater responsibilities.

The A.A.D.S. also formulated amendments to the proposed legislation to recruit dentists for the Armed Forces through grants to students who agree to enter military service upon graduation, and grants for schools which instruct these students. The Association stated that the plan would be acceptable if school participation were put on a voluntary basis, the proposed grant to participating schools were increased and an escalator clause were added.

A proposal that specialty boards undertake the examination of schools offering dental specialty training programs was disapproved. The Association reaffirmed its position that the Council on Dental Education be considered the proper agency for accrediting such schools or specialty programs.

W. D. Postle was inducted as president. M. K. Hine was chosen president-elect; J. E. Buhler, vice-president, and Marion McCrea, secretary-treasurer. H. J. Noyes, Lee Roy Main and R. G. Ellis were elected to the executive committee, R. W. McNulty to the Council on Dental Education and P. C. Kitchin to the National Board of Dental Examiners.

FORMER DEAN OF GEORGETOWN DENTAL SCHOOL DIES

John P. Burke, 54, dean of the Georgetown University School of Dentistry from 1944 until 1950, died March 8 at his home in Chevy Chase, Md. A former member of the House of Delegates of the American Dental Association, Dr. Burke was a past president of the District Dental Society of Washington, D. C., and a member of the International College of Dentists, Omicron Kappa Upsilon, Fédération Dentaire Internationale and the American Association of Dental Consultants.

John P. Burke

He was graduated from the Georgetown University dental school in 1921 and took graduate work at the University of Minnesota. After practicing in that state for several years, he returned to Washington, D. C., to join the faculty of Georgetown University in 1926. He was also appointed chief of the dental staff at Providence Hospital in 1933. Last year, he was a member of the Committee on Local Arrangements for the Association's annual session in Washington, D. C.

ZOLLER MEMORIAL CLINIC OFFERS DENTAL INTERNSHIP

Applications are being accepted for an approved internship including oral diagnosis, all phases of restorative dentistry, oral surgery, anesthesiology and roentgenology, offered in the University of Chicago Clinics through the Walter G. Zoller Memorial Fund.

The intern receives $120 per month stipend, free room in the interns' quarters, laundry and $50 to cover cost of uniforms.

Applications may be made by writing to the Director, Walter G. Zoller Memorial Dental Clinic, Billings Hospital, 950 East 59th Street, Chicago 37.

DENTAL SCHOOLS ANNOUNCE POSTGRADUATE COURSES

New York • A 30-hour course in the principles and procedures needed for good patient relations will be offered June 9-14 by the New York University dental school. Six afternoon sessions will present "procedures of practice management essential for building and retaining a sound dental practice."

Full information may be obtained by writing to the secretary of the postgraduate division, New York University, College of Dentistry, 209 East 23rd Street, New York 10.

Northwestern • The graduate department of orthodontics of Northwestern University Dental School will present a postgraduate course for orthodontists and pedodontists on the analysis of the stomatognathic system, June 30-July 2.

Content of the courses will include normal and abnormal growth of the face; cephalometric analysis of malocclusion and the results of orthodontic therapy; the influence of growth on orthodontic therapy; normal and abnormal function of the temporomandibular joint and a report of research studies; functional analysis of occlusion; management of cleft lip and palate cases.

The faculty will consist of Harry Sicher, John R. Thompson, T. M. Graber and R. W. Donovan.

Further information may be obtained from the dean, Northwestern University Dental School, 311 East Chicago Avenue, Chicago 11.

SCHOENY DISCUSSES AREAS OF DENTAL TEACHER SHORTAGE

Reporting unpublished data at a premeeting conference of the American Association of Dental Schools, Leo S. Schoeny of New Orleans revealed that existing military legislation affects dental school faculties more than medical faculties.

Dr. Schoeny, dental member of the Health Resources Advisory Committee of the Office of Defense Mobilization, demonstrated statistically the extent to which staffs were being depleted. A survey made last year disclosed that two per cent of all dental school teachers had been taken into military service, 5.7 per cent were classified as Priority I or II registrants and 57 per cent were Priority III or IV registrants. Only 30 per cent of the dental faculties were not liable for military service, as compared with 40 per cent of medical school faculties.

Dr. Schoeny's report also showed that dental schools have a greater percentage of young staff members than do medical schools: 46 per cent of dental teachers are 35 years old or younger, as compared with 22 per cent of medical teachers.

Public Health

FLUORIDATION ITEM DELETED FROM USPHS BUDGET BILL

The sum of $1,600,000 for dental research was included in the U. S. Public Health Service budget bill passed by the House of Representatives. The House committee deleted the $250,000 item for grants-in-aid to help states inaugurate fluoridation programs. The committee also declined to appropriate funds for the construction of separate quarters for the National Institute of Dental Research, despite testimony favoring the appropriation.

CUT DENTAL CARE BUDGET OF VETERANS ADMINISTRATION

The Veterans Administration budget bill, as passed by the House of Representatives recently, drastically reduces items for outpatient dental and medical services performed on a fee basis. According to Carl R. Gray, Jr., administrator of veterans affairs, the retrenchment in this outpatient program will amount to $4,000,000. He estimates that the backlog of applications for dental care will total more than 200,000 during the coming year. Other VA programs which will also be curtailed include research, the opening of new hospitals and the staffing of existing hospitals. The VA budget as passed by the House stands at $3,820,000,000.

USPHS ANNUAL REPORT LISTS DENTAL ADVANCES, NEEDS

The annual report of the U. S. Public Health Service, issued April 1, lists advances made during 1951 in dental research and dental services, but presents a critical picture of "the apparently rising prevalence of dental disease and the continuing shift of dentists from civilian practice to the military service."

At the National Institute of Dental Research, under the direction of H. Trendley Dean, 36 research projects were

supported by dental research grants in the past year. The fellowship program supported the work of 16 dental researchers, most of whom studied "the causes and control of dental caries."

The Dental Resources Division of USPHS reports the completion of field work in a study made in cooperation with the American Association of Dental Schools and the Council on Dental Education of the American Dental Association. The study investigated the financial status, staff pattern and needs of dental schools and dental hygiene schools.

The Division of Dental Public Health, reporting on its Grand Rapids, Mich., study, reports, "The fight against . . . dental caries was greatly advanced during the year by clinical proof that the controlled addition of fluoride compounds to public water supplies will reduce incidence of tooth decay by 65 per cent." This division also cited continuance of its topical fluoride programs, children's dental care studies and experiments on the removal of excess fluorides from water.

LEONARD SCHEELE RENAMED SURGEON GENERAL OF USPHS

Leonard A. Scheele was sworn in for his second four-year term as Surgeon General of the U. S. Public Health Service on April 3, after his reappointment by Congress. Except for a period of military service in World War II, Dr. Scheele has been with the USPHS since his graduation from Wayne University School of Medicine in 1933.

NEW YORK CITY ADVISED TO BEGIN FLUORIDATION

A recommendation that New York City should fluoridate its water supplies was presented to Mayor Vincent Impelliteri recently by the American Public Health Association. The health agency, assigned to study city problems by the Mayor's Committee on Management Survey, placed the fluoridation proposal high on the list of recommendations, and estimated that the installation of an adequate fluoridation plant for the city would cost $800,000 annually. This would be a charge of 10 cents a year to each citizen.

CHILDREN'S BUREAU SEEKS FEDERAL FLUORIDATION PLAN

The 1951 annual report of the Social Security Administration, submitted to Congress recently, recommends the fluoridation of community drinking water as a caries-reduction measure. Filed as one of the recommendations of the Children's Bureau is this statement: "Dental caries can be reduced very substantially by introducing fluorides into drinking water or by applying certain fluoride solutions directly to children's teeth."

Other recommendations included in the Social Security report are hospitalization insurance benefits for persons over 65 years of age and reinstatement of the maternity and infant care program for servicemen's families.

NEW FILM ON FLUORIDATION DISTRIBUTED BY USPHS

"A Drop in the Bucket," the U. S. Public Health Service's film on fluoridation, is now available on a loan basis from state departments of health. According to USPHS authorities who distributed the 13-minute film, it is intended primarily for use at community meetings or on TV programs. In telling the story of how one town brought the benefits of fluoridation to its children, the film informs lay audiences of fluoridation's effects, scientific endorsement, cost and technical procedures. Prints are also for sale in color or black-and-white by United World Films, 1445 Park Avenue, New York 29.

Dental Societies

IDAHO DENTISTS TO MEET JUNE 30-JULY 3

Sun Valley will be the site of the 1952 annual meeting of the Idaho State Dental Association, June 30-July 3. Scientific sessions will include table clinics on roentgenology, pathological interpretations of roentgenograms, inlay technic, operative dentistry and third molar implantation. Social events will include golf, barbecue, ice skating and dancing parties.

Further information may be obtained by writing to Frank J. McAtee, president, 401 Idaho Street, Boise, Idaho.

NEW YORK STATE SOCIETY HONORS TWO DENTAL LEADERS

J. L. T. Appleton of Philadelphia and William J. Gies of New York will receive awards from the Dental Society of the State of New York at the Society's 84th annual meeting, May 12-15, in Syracuse.

Dr. Appleton will receive the Jarvie Fellowship Medal, which is awarded annually by the Society to an individual whose contribution has materially advanced the science and art of dentistry. Dr. Gies will receive the Harvey J. Burkhart Scroll, for contributions to dental progress over many years.

Information on the annual meeting of the Dental Society of the State of New York may be obtained by writing to Louis J. Lodico, chairman, 1 Hanson Place, Brooklyn 17.

ARKANSAS DENTISTS HONOR TRUSTEE W. R. ALSTADT

The Arkansas State Dental Association honored W. R. Alstadt, trustee of the American Dental Association from the Twelfth District, at a testimonial banquet on April 7 in Little Rock.

Dr. Alstadt is past president of the Central District Dental Society, a former director of both the American Association of Orthodontists and the Southwestern Society of Orthodontists, a diplomate of the American Board of Orthodontics, a fellow of the International College of

Among the many dental leaders who attended the Kentucky State Dental Association's recent luncheon honoring Robert P. Thomas (r.), were LeRoy M. Ennis (l.), president of the American Dental Association, and Morris J. Wilson (center), president of the Kentucky State Dental Association.

Dr. Thomas is a trustee of the American Dental Association, representing the Sixth District. He is a past president of the Kentucky State Board of Dental Examiners, the Louisville District Dental Society, the Kentucky State Dental Association and the American College of Dentists.

Among the speakers at the luncheon were R. E. Myers, dean of the University of Louisville dental school; Dr. Ennis; Harold Hillenbrand, secretary of the A.D.A.; Clyde E. Minges and J. Ben Robinson, past presidents of the Association; J. B. Carr, trustee representing the Seventh District; Philip L. Schwartz, immediate past president of the American Association of Dental Examiners, and A. P. Williams, secretary of the American Society of Oral Surgeons.

A sterling silver cup, inscribed to W. R. Alstadt "in recognition of his services to the dental profession," was presented to him by the Arkansas State Dental Association at a recent testimonial banquet. Shown at the presentation are (l. to r.) LeRoy M. Ennis, president of the American Dental Association; Dr. Alstadt, trustee representing the Twelfth District; Roy Bucy, president of the Arkansas State Dental Association, and Don Hamm, secretary-treasurer.

Dentists and a former member of the Arkansas State Board of Dental Examiners.

J. D. Jordan of Little Rock presided at the banquet. Among the speakers were LeRoy M. Ennis, president of the American Dental Association; H. M. Flickinger, past president of the Arkansas State Dental Association; Don Hamm, secretary-treasurer of the state association, and Ruth Martin, professor of dental pediatrics, Washington University. Roy Bucy of Rector, Ark., president of the Arkansas State Dental Association, presented an inscribed silver bowl to Dr. Alstadt in the name of the organization. Three hundred persons attended.

International

AWARD FOR DENTAL RESEARCH INSTITUTED BY I.A.D.R.

An annual award has been inaugurated by the International Association of Dental Research to encourage outstanding research by its younger members. Prizes will be awarded to the two best research investigations reported at the organization's annual meeting by persons who have not previously presented a research study elsewhere.

The first prize will be $100 and the second prize, $50. Approved at the recent meeting of the I.A.D.R., the award will be instituted next year.

The International Association admitted to active membership a total of 92 dental researchers, of whom 24 are from England and 11 from other European countries.

Officers of the I.A.D.R. for the coming year are: Maynard K. Hine of Indianapolis, president; Francis A. Arnold of Bethesda, Md., president-elect; G. C. Paffenbarger of Washington, D.C., vice-president; Edward H. Hatton of Chicago, secretary-treasurer, and Dan Y. Burrill of Louisville, Ky., assistant secretary-treasurer.

U. S. DENTISTS TO ATTEND PAN-AMERICAN CONGRESS

The First Dental Congress of Pan-American Universities, to be held May 4-10 in Buenos Aires, Argentina, will be attended by 20 dental educators from the United States. Stanley D. Tylman of Chicago will speak on dental education in the keynote speech of the Congress.

Others who will attend are: O. C. Applegate of Ann Arbor, Mich.; Don Jose Aubertine of San Francisco; R. B. Black of Corpus Christi, Texas; H. Trendley Dean of Washington, D. C.; S. C. Fournet of New Orleans; Arthur B. Gabel of Philadelphia; Cloyd S. Harkins of Osceola Mills, Pa.; Rex Ingraham of

Los Angeles; Philip Jay of Ann Arbor; Alfred Nelson of Royal Oak, Mich.; Floyd Peyton of Ann Arbor; Earl Pound of Los Angeles; Victor Sears of Salt Lake City; Harry Sicher of Chicago; Morris Thompson of Beverly Hills, Calif.; G. D. Timmons of Philadelphia; Harry True of San Francisco and William Ward Wainwright of Chicago.

Guillermo A. Bizzozero of Buenos Aires is president of the Congress.

MEXICAN DENTAL STUDY CLUB TO HOLD ANNUAL SEMINAR

The fifth annual seminar of the University of Southern California Dental Study Club of Mexico will be held May 18-21 in the Hotel Garcicrespo, Tehuacán, Mexico.

Among the lecturers are five from the United States: LeRoy M. Ennis, on roentgenology; Talbot Foster, on oral surgery; C. H. Blanchard on prosthetic dentistry, and Gordon Douglas Campbell, on psychosomatics in dentistry. Guillermo Riquelme of Mexico City is secretary of the seminar.

NEW PLANS FOR INTERNATIONAL DENTAL CONGRESS ANNOUNCED

Demonstrations of oral surgery, roentgenology, plastic surgery, cleft palate treatment and anesthetics will be presented by 10 London hospitals during the Eleventh International Dental Congress, July 19-26 in London, England.

This program was among the latest arrangements announced by the organizing committee of the Congress. The committee also reported that the Ministry of Health will give a reception for members of the Congress; a temporary post office will be set up in the Royal Festival Hall and a special cancelling stamp used on letters mailed from the Congress; 400 earphones will be used in the Royal Festival Hall, for simultaneous translation of reports and discussion; 177 separate demonstrations will be included in the scientific program.

A total of 1,500 registrants are reported by the committee.

Further information about the Congress may be obtained by writing to Gerald H. Leatherman, Honorary Secretary, 35 Devonshire Place, London W. 1, England.

DEBATE ON DENTISTS BILL CONTINUES IN GREAT BRITAIN

In Great Britain, several proposals designed to restrict the activities of dental ancillary workers were defeated during the March debates on the Dentists Bill in the House of Lords.

The first proposal would have limited ancillaries to examination, scaling and polishing. The second would have amended the bill to insert the word "personal" into the phrase "under the supervision of a registered dentist." However, one concession has been made to the dental profession: the Privy Council will have to consult the newly-formed General Dental Council before introducing dental ancillaries into the School Service. The bill's provisions "still fall far short of being wholly acceptable," according to the *British Dental Journal*.

PERUVIAN DENTAL SOCIETY ANNOUNCES NEW OFFICERS

Arturo Rojas of Lima, Peru, has been elected to a three-year term as president of the Sociedad Peruana de Ortodoncia. Other officers recently chosen for the 1952-54 administration are: Agusto Taiman Villar, vice-president; Naldo Balarezo Gerstein, secretary and director of publications; Miguel Herrera Orrego, treasurer, and Carlos Elbers Espinoza, librarian. Members of the Board of Directors are Ricardo Salazar Southwell, Juan

F. Coz, Guillermo Otero Gaymer, Demetrio Calderon Gonzales and Juan Camino Sanchez.

Legislation

FREE DENTAL CARE PROPOSED FOR VETERANS' CHILDREN

A bill to grant free outpatient medical and dental treatment to children of deceased veterans was introduced in Congress by Rep. Harry P. O'Neill (D., Pa.) on March 31. The bill, HR 7320, would authorize the administrator of veterans affairs to direct the program under the same regulations as now apply to veterans themselves.

Another bill extending federal health benefits was introduced recently by Sen. J. E. Murray (D., Mont.) and Rep. John D. Dingell (D., Mich.). The companion bills provide for the government-paid hospital care of about seven million social security beneficiaries. These would include persons over 65, wives, widows and orphans of insured workers.

SENATE APPROVES BILL ON WOMEN DENTAL OFFICERS

The Senate recently passed S 2552, a bill to authorize the appointment of qualified women as physicians and dentists in the Army, Navy and Air Force. If passed by the House, the bill will enable the armed services to grant commissions to women physicians and dentists on the same basis as men and to appoint women to their regular Medical and Dental Corps. S 2552 was introduced by Sen. Lester C. Hunt (D., Wyo.); a companion bill in the House, HR 6288, was introduced by Rep. Carl T. Durham (D., N.C.).

General

SOCIETY OF ORAL SURGEONS TO HEAR TALK ON TUMORS

The Metropolitan New York Society of Oral Surgeons will meet at 8 P.M. May 7, 1952 at the Hotel New Yorker. The meeting will be addressed by Frank S. Butler of New York City, attending surgeon at Bellevue and University Hospitals and chief of Columbus Hospital Tumor Clinic. Dr. Butler is also attending surgeon to the oral surgery department at the New York University School of Dentistry and Tumor Clinic. He will speak on "Diagnosis and Treatment of Malignant Diseases of the Mouth."

Further information on the meeting may be obtained by writing Russell C. Sherman, Suite 605, Professional Building, 1313 Fulton Avenue, Hempstead, N. Y.

NEW DENTAL SPECIALTY BOARD TO HOLD FIRST EXAMINATIONS

The American Board of Dental Public Health will examine applicants for certification on September 12 and 13 in St. Louis, following the annual meeting of the American Dental Association.

The requirements of the Board were recommended by the Council on Dental Education and approved by the House of Delegates in 1951. The Board was established in 1950 by the American Association of Public Health Dentists and the Dental Health Section of the American Public Health Association. Its purpose is to study and create standards for the practice of dental public health and to grant to qualified dentists certificates of special knowledge and ability in preventive dentistry and dental public health.

Arnold T. Goldwater of New York City, a member of the art group of the First District Dental Society, recently won the first-prize gold medal in the National Amateur Painters' Competition conducted by Art News. His prize-winning watercolor painting, "Verdi Square," is reproduced here. A dentist since 1910, Dr. Goldwater states that painting is "a relaxing and interesting change from professional duties."

Application forms may be obtained by writing to Philip E. Blackerby, Jr., secretary-treasurer, 250 Champion Street, Battle Creek, Mich.

CONVOCATION OF AMERICAN COLLEGE OF DENTISTS SET

The convocation of the American College of Dentists will be held September 7, in the Statler Hotel, St. Louis. The meeting will consist of morning, luncheon, afternoon and evening sessions. Further information may be obtained from Otto W. Brandhorst, secretary, 4952 Maryland Avenue, St. Louis 8.

ARMED FORCES INSTITUTE TO DISPLAY DENTAL RELICS

On May 21, the Armed Forces Institute of Pathology, Washington, D. C., will observe its ninetieth anniversary by opening to the public an exhibit of historic dental and medical materials.

In 1898, the Institute, formerly called the Army Medical Museum, was officially designated as the National Dental Museum of the American (National) Dental Association. Historic dental instruments and dentures were collected there and will be displayed in the exhibit, as well as modern dental materials.

The Institute, founded in 1862 as a center for research and study on military injuries, is a central laboratory for diagnosis, research and instruction by the Army, Navy, Air Force, Veterans Administration and other federal agencies.

TEMPLE DENTAL ALUMNI TO HOLD REUNION MAY 21

When the Temple University Dental Alumni Association assembles for its annual reunion in Philadelphia May 21, Lewis Fox will present a series of lectures on "Why Occlusion." Following the sessions at the dental school, the organization's annual reunion dinner will be held at the Warwick Hotel. Further information may be obtained from Richard Mears, president, Montgomery Avenue and Cynwyd Road, Bala-Cynwyd, Pa.

Book Reviews

REMINGTON'S PRACTICE OF PHARMACY

By E. Fullerton Cook, Ph.M., M.Sc., D.Sc., and Eric W. Martin, Ph.C., M.S., Ph.D. Tenth edition. 1,616 pages with 805 illustrations. No price listed. Easton, Pa., Mack Pub. Co., 1951.

This book, subtitled "A Treatise," contains an overwhelming quantity of information concerning the historical and practical aspects of pharmacy. The text appears to be well organized. All of the official products and processes are stated to have been revised in conformity with U.S.P., fourteenth edition, and N.F., ninth edition, listings.

Dental preparations are briefly considered in chapter 96. This portion should provide useful information to the pharmacist. It contains cautionary statements concerning those preparations that require judicious handling. Almost all of the examples given are taken from *Accepted Dental Remedies,* which is recommended to the pharmacist as a reliable reference book.

Elsewhere in the book, statements appear in conflict with the contents of this excellent three page chapter and with generally accepted scientific viewpoints. It is recognized that the pharmacist should be in a position to compound preparations that the dentist or physician may prescribe. It is unfortunate, however, that this book contains information which may encourage the pharmacist to promote preparations directly to the public without competent diagnosis, and particularly when the preparations may actually be harmful or of questionable usefulness. For example, on page 293, it is recommended that a dentifrice "should contain an antiseptic to assist in eliminating the millions of bacteria lodged in the oral crevices." On the same page, N.F. aromatic sodium perborate is said to be "used a great deal for Vincent's infection of the mouth." On page 149, the N.F. dentifrice is recommended as a "splendid vehicle for medication e.g. sodium perborate or astringent substances." The advent of antibiotic agents has rendered the foregoing treatments obsolete.

The authors obviously are ill-informed with regard to current scientific views in oral therapeutics. The book is so replete with details that it is frequently difficult to extract specific bits of information from the mass of material. Many of the illustrations depict equipment that has disappeared from the market. For the same reason, several of the diagrams are of questionable usefulness.

Although this book may find application as a reference handbook in the education of the pharmacist, its value to the dentist or dental student is not significant. It contains little practical information that the dentist may not readily obtain from *Accepted Dental Remedies,* the *United States Pharmacopeia* or the *National Formulary.*

PHARMAKOLOGIE FÜR ZAHNÄRZTE UND STUDIERENDE DER ZAHNHEILKUNDE (PHARMACOLOGY FOR DENTISTS)

By Klaus Soehring, 246 pages. Index. 21 tables, 19 illustrations. Konstanz, Germany, Zahnarztliche Welt, 1951.

The subject is presented from the broad biological and chemical viewpoint of general medicine rather than from the specialized field of dentistry alone. The material is recent and considered on a theoretical basis as regards mode of action. Many specific and practical examples of therapeutic compounds are given; however, no definite recommendations are made. *Accepted Dental Remedies, 1950,* is one of the author's sources of information. (There are relatively few significant disagreements between the two books, but one is on the value of fluorides in caries control.)

The book is divided into three parts. The first, pharmacology of combating infection, contains a comprehensive chapter on physical and chemical methods of disinfection developed from concepts of bacteriology and hygiene. This is extended to a chapter on control of infection in the mouth. The second part deals with the autonomic nervous system and the actions of hypnotics, sedatives and antipyretics. This section also includes material on circulation and respiration and a good discussion of control of chronic and acute pain.

Through a technical misfortune, the original index contains erroneous page numbers. This has been remedied by the inclusion of a corrected insert.

The wide scope of the book makes interesting reading but at the same time prohibits the full treatment of several important aspects, particularly the antibiotics.

Walter Mahler

FROM A DOCTOR'S HEART

By Eugene F. Snyder, M.D. 251 pages, 16 illustrations. Index. Price $3.75. New York, Philosophical Library, 1951.

This story begins with the first coronary occlusion of a physician-philosopher, and takes place during the period of convalescence in a hospital which follows. It is composed primarily of a series of bedside discussions between the author, his physician wife, and their intelligent and inquisitive teen-age son on the subjects of heart disease and medicine in general. Interspersed among their conversations are the meditations of the author on the diverse subjects of life and death, the art of medicine, politics, and religion, along with well-chosen anecdotes to illustrate his philosophy.

The technical information relating to heart disease, and particularly its psychosomatic elements, is accurate and well-presented. This information alone would justify the publication and wide reading of this work even without the spiritually inspiring portions dealing with the author's philosophy which make the book such pleasant reading. The illustrations by R. V. Tribe, a cartoonist, are well done and amusing.

In addition to the great value the book would have for patients with heart disease, every professional or business worker who is under pressure should read it in the interests of self-preservation and should relearn the lessons on the prophylaxis of coronary heart disease.

Mary R. Richards

ZAHNÄRZTLICHE PROBLEME IN DER KINDERHEILKUNDE (DENTAL PROBLEMS IN PEDIATRICS)

By F. Perabo, Dr. Med. et Med. Dent. 120 pages with 121 illustrations. Basel, Switzerland, Benno Schwabe and Co., 1951.

This small volume is attractively printed and beautifully illustrated. It is concerned with dental and oral problems which the pediatrician might encounter in the children under his care. It concentrates exclusively on the pediatric viewpoint so that the conditions described are those commonly seen in hospital wards rather than those encountered in private practice.

The book begins with a simple but clear discussion of tooth development and then carries the physician through dental caries, pulpitis, focal infection, periapical and periodontal diseases, inflammatory (infectious) diseases of the mouth, oral tumors, dental extractions, subluxation and fractures of the jaws and normal and abnormal occlusion of the teeth and jaws.

Most of the information is of a basic nature and is fundamentally acceptable to almost all dental practitioners. Occasionally the author inserts more controversial matter such as the symmetrical extraction of permanent first molars when one tooth is already lost, in order to "balance" the occlusion. For the American audience the section on dental caries does not consider caries control (by sugar control and fluoride therapy) in sufficient detail. Caries control is, in fact, not often stressed in the European literature.

This book can be highly recommended to the pediatrician, either practitioner or teacher. The pedodontist would benefit greatly from reading this volume carefully. It is to be hoped that someone will translate this book into English since the need for such a volume is obvious.

Maury Massler

TECHNIQUE CHIRURGICALE STOMATOLOGIQUE

Chompret, Dechaume and Richard. Third edition. 365 pages with 206 illustrations. Index. Price 1,650 francs. Paris, France: Masson & Cie., 1951.

This book, the third volume of *La Pratique Stomatologique*, is one of the latest on oral surgery published in France. In the introduction the authors state that they hope to provide the student as well as the general practitioner with a practical guide. However, they attempt to view technic in the broader perspective of science.

Part 1 gives a brief description of the anatomy of the maxillofacial region. Part 2 is a short enumeration of the requirements for the operating room. Part 3 is devoted to preoperative and postoperative care and the treatment of possible complications. Part 4 deals with general, regional and local anesthetics with a brief discussion on indications for use, advantages and disadvantages of each. Part 5 describes the technic of extraction with special emphasis on removal of third molars, infected teeth and roots. The need for special care when dealing with children is also discussed. The prevention and treatment of accidents and complications therefrom are covered in Parts 4 and 5.

Part 6 describes surgical intervention on the bones of the jaw: extraction of impacted teeth and apicoectomy. A brief chapter on tooth implantation, the treatment of cysts,

tumors, fractures, osteitis and necrosis, sinusitis in connection with tooth infection, and temporomandibular joint diseases is included. Surgical treatment of various diseases of the soft tissues (infections, cysts, tumors and fistulas) is covered in Part 7. A short chapter describes biopsy technic.

The correction of congenital and acquired deformities, such as surgical preparation for prosthetic appliances, closing of fistulas between the mouth and sinus, treatment of skin fistulas and wounds of the face and ugly scars are included in Part 8. The book closes with a short review of first aid in extensive mutilations of the maxillofacial region, the accepted principles of treatment and restoration by plastic surgery.

This book is not a complete guide for oral surgery. It gives, rather, a review of the possibilities and the most important steps in various interventions in oral surgery. The minor operations are more fully described. It is written in a clear and simple manner.

Georges A. Feys

MAN AND HIS YEARS

By Federal Security Agency. First edition. 311 pages. Index. Price $3.25. Raleigh, N. C., Health Publications Institute, Inc., 1951.

At first glance, this study has the appearance of a come-lately move of the Federal Security Agency to advise on problems of the aging, which already have been given serious attention at many local and state levels. The time lag is emphasized in a summary of nationwide activities already in operation, presented in the final chapter by Clark Tibbitts, the conference director.

The study had the benefit of good cooperation from authorities in certain fields under discussion. Eleven report chapters are presented, each the product of a special committee assigned to a specific field. These fields include population changes, education, health maintenance and rehabilitation, employment, family life, recreation, religion and community organization.

Dentists will be interested in the chapter on health maintenance, in which the significant point is made that this is basically an individual matter and that no dentist or physician, social service or health program can substitute for individual initiative and effort.

The importance of early detection of health deterioration is emphasized, with consideration of individual health inventory and mass screening. The report suggests that increase in public assistance payments might permit more extensive health care. The section concludes that increased financial support is needed from all possible sources. An extensive summary is presented at the end of the chapter.

It can be said that this volume is helpful to the extent that it brings together under one cover the various approaches that should be made in attempting to solve those problems of aging that can be attacked with reasonable chance of success. The average worker in the healing arts will find it provides informative background.

William W. Bolton

EXPERIMENT IN DENTAL CARE

By John T. Fulton, D.D.S. 87 pages with 24 tables and charts and 4 illustrations. Price $1. Geneva, Switzerland, World Health Organization, 1951.

This monograph gives an unbiased report on the New Zealand Dental Program and its use of school dental nurses. The report is detailed, based on an adequate number of children, mouth mirror and explorer examinations, sufficiently diversified sampling to preclude a regional bias, and is a statement of factual observations, not preconceived objections.

In the opening chapter, one paragraph probably better describes the monograph than any summary by a reviewer. "'What is disclosed here is a picture of the prevalence of dental caries in the average New Zealand schoolchild in the age-range of 7 through 14, the results of an attempt to cope with the problem by regular dental care in the form of fillings, and the extent of failure in this attempt as manifested in tooth mortality." The report adequately fulfills the objective indicated in the above paragraph.

The second section of the report deals with the administrative aspects, costs, history, training of the school dental nurse and organization of the dental profession. It is unfortunate that a clear demarcation by section heading or similar device could not have been made between these two phases of the report. This last phase is well done and is enlightening.

The third part of the report is found in the appendix. This deals with types of forms used, samples of examination questions given the dental nurses, and the general instructions for the carrying out of the program.

For many years the dental profession and public health profession of the United States have indulged in speculation, criticism, and pointless debate on the subject of the New Zealand Dental Program without actually having unbiased, factual material from which to

draw conclusions. This monograph presents just this sort of necessary information secured by a trained, practical observer. A careful analysis of the data presented, and thoughtful study of the second section of the report, should lead to a much better understanding of the results, problems, and ideals of the New Zealand Dental Program. It is earnestly recommended for your thoughtful reading. It is an excellent example of fine reporting.

H. Shirley Dwyer

PROTHESE DENTAIRE AMOVIBLE OU ADJOINTE

By H. Guilly, Ch. L'Hirondel and R. Thibault. Third edition. 760 pages with 839 illustrations. Index. Price 2,600 francs. Paris, France, Masson et cie., 1951.

This book, volume five of *La Pratique Stomatologique*, deals with removable dental prosthetic appliances.

The first two parts discuss materials, facial anatomy, partial dentures and removable bridges. Although these chapters are intended to be complete, they lack some methods now widely used in technical procedure. Very little space is accorded to hydrocolloidal impression materials and no mention is made of the use of hydrocal or vibrators. Insufficient space is assigned to removable bridges, but full, amply illustrated descriptions are devoted to some procedures now rarely used.

A large section is allotted to discussion of stainless steel and can be attributed to present conditions in some parts of Europe. In other sections, the reader will note that several controversial statements are presented without any discussion, and that a few technics generally considered unsatisfactory are recommended. These include rebasing in the mouth with self-curing acrylic resins and the quick polymerizing by heat of these resins.

In contrast, some chapters are complete and interesting, including one on physiology and another on anatomy, the second noteworthy in its description of the normal aspect of the face.

The third part of the volume, dealing with complete dentures, is up-to-date but necessarily limited, since the whole technic of complete dentures cannot be described satisfactorily in 135 pages.

Examination, various impression technics and model casting precede the explanation of the Hanau, Gysi and Villain methods of recording articulation and mounting models on the articulator. The author also describes setting of the teeth, festooning, checking dentures in the mouth, processing, repairing and relining. A short chapter on immediate dentures and one on the use of metallic bases in full dentures complete the book.

Georges A. Feys

INTRODUCTORY COLLEGE CHEMISTRY

By Harry N. Holmes. Fifth edition. 594 pages with 178 figures. Index. Price $4.75. New York, The Macmillan Co., 1951.

Writing a suitable textbook for an introductory course in college chemistry is probably one of the most difficult and frustrating problems an author can face. When almost all of our physical world is participating in chemical changes of all sorts, what fraction of them should one include in the textbook? What fraction should one omit?

In this latest edition, author Holmes has decided in favor of exposing the reader (student) not only to the usual didactic chemistry, but also to the maximum possible number of practical applications, or occurrences, consistent with the size of the book. Although several applications seem far too complex for the simple chemistry with which they are associated, the majority of examples are well chosen and certainly represent areas in which the knowledge will be of some use. For example, Charles' Law is applied to power from expanding gases (pages 76-79).

Assuming that some of the students who read this text are to proceed no further along scientific lines, the author is well justified in including all these practical lines of information.

Perhaps the only major criticism of the text lies not in what is said but in how it is said. To cover the most ground in fewest words, author Holmes has deliberately sacrificed smoothness in continuity of thought. On pages 16-17 in the space of three sentences, the main theme jumps from electrons to radium, to uncontrolled radioactive disintegration. Actually, all of these are associated in the text, but the sentences have to be studied carefully to arrive at this conclusion. The most conspicuous error seems to be an indiscriminate use of "atom" (page 229 and 232) for "nucleus." This error is not committed on pages 231 and 233 and elsewhere, which is all the more surprising.

The scope of this book is all encompassing. Certainly mastery of its contents will provide a student with a marvelous background for initial recognition of the chemistry in the world about him.

B. F. Gurney

PHARMACOLOGY AND PHARMACOTHERAPEUTICS FOR DENTISTS

By William H. O. McGehee and Melvin W. Green. Fourth edition. 550 pages. Index. New York, The Blakiston Co., 1952.

Any text on dental pharmacology and therapeutics will be compared with books such as *Accepted Dental Remedies* and *New and Nonofficial Remedies* on the one hand, and large texts on pharmacology and therapeutics on the other.

The information in dental pharmacology texts is not likely to be as recent as that in *Accepted Dental Remedies* which is revised annually, nor is it likely to be as comprehensive as that found in the large texts on general pharmacology.

This book by McGehee and Green is very good, considering the limitations which exist for any text of its kind. It contains a large quantity of concise and readable information, edited according to modern standards. It should be a useful reference work for practicing dentists and a satisfactory text for undergraduate courses in dental pharmacology and therapeutics.

DIE RATIONALISIERTE APEKTOMIE (THE RATIONALIZED ROOT RESECTION)

By A. P. Sargenti. 64 pages with 51 illustrations. Bern, Switzerland, Hans Huber, 1951.

The author claims that root resection is not practiced enough for the following reasons: too many instruments may be needed; an assistant is usually necessary; the surgery takes too long, and tissues are often traumatized. The author contends that all of these difficulties can be overcome by a simplified technic. He describes this technic, "rationalized root resection," in a detailed text and series of photographs.

An incision is made in a straight line occlusally from the apex. Sometimes a vertical incision is made at one end of the straight incision. After the operation, the wound is not sutured; the flap is laid over the area and left to heal by second intention. No chisels are used to open the bone. Instead, a specially-built trephine cuts bone and apex in one operation. Root canal filling is done prior to surgery by mechanically widening the canal and filling it with an ivory-silver root canal point of the same diameter as the root canal reamer last used. The point's apex is cemented into place.

The author claims that this technic overcomes the objections to root canal resection listed above. It is quick, reduces trauma and requires only a few special instruments. No assistant is needed, as the operator may use a wound margin holder which is held with one hand.

Illustrations of this technic are excellent. Even those who cannot read German can follow the author by viewing the illustrations. The book is printed well, on good paper.

The author apparently achieves good results although some of his suggestions do not seem to follow sound surgical principles and sterilizing technics.

Balint Orban

NUTRITION AND CLIMATIC STRESS— WITH PARTICULAR REFERENCE TO MAN

By H. H. Mitchell and Marjorie Edman. 234 pages. Index. Price $6.75. Springfield, Illinois, Charles C Thomas, 1951.

This book covers thoroughly and critically those experiments dealing directly with the relationships of nutrition and climatic stress, the effect of climatic stress on nutritional requirements and the effect of the food supply upon tolerance to climatic stress.

Diet in a cold environment, in a hot environment and at a range of altitudes is investigated. Not only is there a clearly stated critical analysis of the experimental and observational findings as presented, but each division has its own summary and conclusions. The last chapter discusses practical considerations.

Certain types of diets have been shown to be advantageous in certain climates; however, the authors caution that often engineering and technological advances are more effective than dietary modifications in relieving climatic stress. Diet assumes major importance when certain critical conditions make it advisable to take advantage of every available supplementary expedient in promoting personal efficiency. Such conditions include polar or sub-polar missions or airplane flights at extreme altitudes. Thus, this book is important to anyone responsible for devising such special rations.

Perhaps even greater value is to be obtained from this compilation as an aid to all who are concerned with laboratory investigations that deal with human dietaries. The authors demonstrate clearly that at times animal experimentation has furnished an unsafe guide to human responses in climatic and dietary changes and interactions. Therefore, although some problems in this area may require pilot

animal experimentation, for most problems that concern man, the human subject should be employed and in sufficient numbers to establish the statistical validity of the experimental effects that may be observed.

The authors state that the works they cite have been selected for reference from a much larger bibliography on the basis of pertinence to the main problem. Even so, the listing requires 59 pages.

This book is recommended to everyone working on any aspect of human dietary needs.

Dorothea F. Radusch

SAINTS, SINNERS AND PSYCHIATRY— THE KEY TO MENTAL HAPPINESS

By Camilla M. Anderson, M.D. 206 pages. Index. Price $2.95. Philadelphia, J. B. Lippincott Co., 1950.

This book, as evidenced by its subtitle, "The Key to Mental Happiness," is another in the rather long series of volumes designed to stimulate various persons to self-help and understanding.

The blurb on the jacket, however, holds that this book is different and that the author has presented a somewhat novel theory in an attempt "to clarify the basic motivations which dominate human activity and to relate overt manifestations of personality to the basic subconscious drives." This is really too ambitious a purpose for a book which is an effort at popularization and which succeeds in over-simplification.

Case histories are presented to illustrate certain points and from these the author takes off to her own discussion and conclusions. It may be that this procedure will provide "the key to mental happiness" for a limited few; others will need considerably more.

The author's style seems to be based on recent studies which apparently reveal that sentences of a certain length are best understood. In keeping sentences to this standard of uniform length, the book is a success.

PROBLEMS OF AGING: TRANSACTIONS OF THE THIRTEENTH CONFERENCE, 1951

Edited by Nathan W. Shock. 194 pages with 24 illustrations. Price $4. New York, Josiah Macy, Jr., Foundation, 1951.

This volume is the third of a series dealing with various phases of the general subject of aging. It considers specific manifestations of structural and functional changes occurring within the body as part of the aging process. Among areas considered are the endocrine system, the cardiovascular system and the skin and its underlying tissues.

Discussion is presented as a verbatim report of the thirteenth Conference on Problems of the Aging, with each member's contribution indicated. This presentation makes for stimulating reading, because one easily falls into the sense of being an active participant. At the same time, this method results in the inclusion of some unnecessary verbiage. Since all of the participants are specialists in their fields, data provided can be accepted as authoritative.

In a special chapter, W. Jacobson, research authority from Cambridge, England, presents an instructive report on his studies of cell mitosis with reference to the roles various chemical constituents may play in aging.

The volume offers important data regarding significant changes occurring in the body as accompaniments of aging, and should be of wide interest in all professional areas.

William W. Bolton

INHALATION ANESTHESIA— A FUNDAMENTAL GUIDE

By Arthur E. Guedel. Second edition. 143 pages with 6 illustrative charts. Index. Price $3.75. New York, The Macmillan Co., 1951.

Arthur Guedel has written a remarkably good "fundamental guide," presenting in 133 comparatively small pages the basic information which any dentist using inhalation anesthesia should know. To quote from the preface written for the first edition of this book: "Like the road map for the motorist, this outline is intended to guide the anesthetist up to and through his first few general anesthesias. It is not complete in detail save where detail is necessary, as in 'Signs of Anesthesia.' It intentionally treats lightly the more complicated physiologic and pharmacologic mechanisms, describing these only to the extent necessary in their clinical application."

This book is divided into two sections. The first describes the mechanism of inhalation anesthesia. The author charts four stages of anesthesia and divides the third stage, surgical anesthesia, into four planes. With this as a basis, he discusses the signs exhibited by the patient in each of these divisions. In this portion of the book the author observes that "1. Practically everything concerned with the anesthesia of forty years ago was of a nature to increase the oxygen requirement and decrease the oxygen supply of the body during

the anesthesia. 2. Practically all improvements in anesthesia . . . have been of a nature to decrease the oxygen requirement and increase the oxygen supply of the body during anesthesia."

The author points out that the metabolic rate of a patient is important, as it represents his oxygen demand and nervous irritability. In a discussion of the use of opium and barbituric acid derivatives, the author describes their use in lowering the metabolic rate of the patient and hence the irritability of his nervous system.

The second section of the book deals with accidents which may occur during anesthesia. Under cerebral asphyxia, the author comments that four minutes is now the generally accepted maximal period of unrelieved apnea without some degree of cortical destruction. "Such asphyxial accidents occur more frequently with nitrous oxide than with other anesthetic agents," the author comments. "It is not that there is too much nitrous oxide but that there is too little oxygen in the anesthetic mixture."

In dealing with explosive hazards, the author again refers to nitrous oxide. "This gas is not inflammable," he states. "Its support of combustion, however, may be considered almost equal to that of oxygen. When it is mixed with any inflammable anesthetic agent in proper proportion, it may explode with a violence seemingly equal to that of the same agent with oxygen. There have been some fatal explosions with nitrous oxide-ether mixtures."

Dr. Guedel's book would seem to be a valuable source of information for any dentist who uses inhalation anesthesia.

Warren R. Schram

THE PHYSICAL ANTHROPOLOGY OF THE AMERICAN INDIAN

Edited by William S. Laughlin. 202 pages with 47 illustrations. Extensive bibliography. No price listed. New York, The Viking Fund, Inc., 1951.

To a student of anthropology this is a most informative volume. The six papers comprising the book were delivered at the Fourth Viking Fund Summer Seminar in Physical Anthropology. They discuss the origin of our American Indians and attempt to theorize on the possible migration of their aboriginal ancestors, through a scientific comparison of their anthropological characteristics.

Of most interest to dentists is the paper presented by Albert A. Dahlberg on "The Dentition of the American Indian." He states, "Perhaps the most typical dental character of the American Indian is the so-called shovel-shaper incisor." In a study of Pima Indians he noted that 99 per cent of the females and 96 per cent of the males possessed this characteristic. The lower incisors, though shovel-shaped, are considerably modified.

"The premolars of the Indians are not pertinently different from other populations," Dahlberg reports. "However, the general statement can be made that Indian teeth are less specialized in most respects than other racial groups." He further points out that "Indians have intensified certain ancestral dental characters and modified others. The Indian dentition can be described as having large teeth, pronounced shovel-shaped incisors with occasional barrel-shaped lateral incisors, triangular occlusal surfaces on lower first deciduous molars, a high incidence of three-cusped upper second and third molars, a high percentage of grooved and five cusped second and third lower molars and a low percentage of small carabelli's cusp."

This little volume should prove of great value to students of anthropology and belongs in every college library where anthropological studies and research are being pursued.

H. Shirley Dwyer

MARRIAGE AND THE JEWISH TRADITION: TOWARD A MODERN PHILOSOPHY OF FAMILY LIVING

Edited by Stanley R. Brav. 218 pages. Price $3.75. New York, Philosophical Library, 1951.

The editor of this anthology on Jewish marriage deserves credit for having chosen its chapters wisely. Papers by fifteen authors present the historical backdrop of Jewish tradition, including the Talmudic, sociological and philosophical views on Jewish marriage. Treatment ranges from the poetic and preaching to the analytic, scientific and practical, making this book an important source of reference on the subject of Jewish marriage and marriage in general.

Apparently, the editor had two purposes in mind. First, to substantiate the distinct quality of the Jewish family, assumed by poets, playwrights, philosophers and sociologists. In the opinion of this reviewer, he has failed to achieve this first goal. The unique and close family relationship of the Jews appears to have been more evident in former times, and very little evidence is offered that this family solidarity still exists. The Jewish values which should preserve the Jewish family in a

changing and changed world are found in the past. It is not quite clear how they would apply to the present situation, which finds little understanding but more criticism on the part of most contributors.

For this reason, the second purpose, indicated by the sub-title, seems to this reviewer to fall short of its aims. Few chapters deal constructively with the problem and needs of the present generation. The most pertinent contributions in this regard speak about modern marriage in general and not about the Jewish marriage in particular.

Little evidence can be found in this volume that the Jewish tradition makes the problems of the modern Jewish marriage different from those of married couples in general. Any effort to use tradition as a guide in modern times must obviously neglect some principles and emphasize others. One may then question the benefit of traditional orientation as contrasted to the recognition of present needs and conflicts. This otherwise exceedingly interesting book does not answer that question.

Rudolf Dreikurs

THE ISOCORTEX OF MAN

By Percival Bailey, M.D., and Gerhardt von Bonin, M.D. 301 pages with 121 figures and 17 full page plates. No index. Price $5 paper and $6 cloth. Urbana, University of Illinois Press, 1951.

This monograph with accompanying charts and diagrams represents a considerable outlay of time and money to go over ground that seemingly has been explored carefully. The opportunity to make a thorough study of the brain of a healthy young man could not be rejected, however, especially since this brain was in the hands of expert technicians within an hour after death.

The considerable outlay referred to by the authors has been abundantly justified by this splendid presentation of the cortical architecture of the human brain. The study was produced by a highly gifted and coordinated group of technicians, including the two authors and their numerous assistants. Included are a critical review of previous similar studies and an excellent bibliography.

Obviously, the goal of such a detailed anatomic study is its possible relationship to function and the use of such coordination for the relief of suffering and disease. In this respect the authors conclude that our knowledge of the brain structure is so rudimentary that we can formulate only the crudest hypotheses concerning the manner of functioning of the cerebral cortex. This conclusion must be accepted; there seems to be no alternative.

The book is aimed at workers in this special field and those familiar with its literature and technical terminology. However, the last chapter on "Functional Significance" is of more general interest. The following quotation is offered as an example: "It is clear to most students that the cortex can be likened to a calculating machine with greater justification than to a slot machine, although even this simile breaks down eventually . . . as no machine has been constructed that can outwit the brain in choosing goals."

No investigation of this type can be brought to a successful conclusion without substantial help from persons and institutions. The Office of Naval Research and the University of Illinois Press are to be congratulated for their assistance.

Edward H. Hatton

Current Literature

SURGICAL TREATMENT OF PERIODONTAL DISEASES

Winston V. Cruzan. Mil. Surg. 109:102, August, 1951.

Periodontal treatments are a practical reality. Patients with periodontal disease deserve that the best possible efforts of the dentist be directed toward the saving of the involved teeth. The Armed Forces have established a postgraduate training program to give their personnel specialized training which includes training in periodontology.

The periodontal patient in military service must be handled differently from a civilian patient because the uncertainty of change of station makes prolonged treatments inadvisable. Cases that do not respond favorably to one or two treatments with subgingival curettage require surgical procedures. The military patient also must be made to understand the extreme importance of home care for he does not have the added incentive of the payment of a professional fee.

The instruments for the surgical treatments are arranged on a Mayo table which is draped with sterile towels. They are placed in the following order: surgical knives, Ward-Kaiser interproximal curets, small scissors, mosquito hemostats, Kirkland curets and scalers and instruments for applying the surgical pack. A warm sterile saline solution for a spray and an aspirator are also needed. The area of operation generally is confined to one quadrant of the mouth per sitting. Pentobarbital sodium (Nembutal), one and a half grains, is used for premedication when needed. Two per cent procaine hydrochloride is used for anesthesia.

After cleaning the field with water, Tincture of Metaphen is applied to the teeth and gingivae with a rubber cup mounted on a Porte polisher. The pocket depth is marked with the point of the probe creating small spots of hemorrhage which serve as guides for the depth of incision. The initial incision on the buccal surfaces is made with a number 15 Bard-Parker blade maintaining the normal contour and a bevel to the incisal edge whenever possible. The no. 1 curet and mosquito hemostats are used to remove the incised gingiva. Ward-Kaiser interproximal curets are used to remove the granulation tissue and the small scissors to trim and contour the tissues. The Kirkland curets are then used to remove calculus. When this procedure is completed, Tincture of Metaphen is again applied.

A powder of two parts zinc oxide, two parts powdered rosin and one part tannic acid (powder) is mixed with 12 to 14 drops of liquid which is made by dissolving a piece of rosin the size of a dime in one ounce of eugenol heated in a test tube over a Bunsen burner and adding one-half ounce of peanut oil. When the material becomes firm but not hard, it is rolled into three strips about one-eighth inch in diameter and four inches long. One strip is cut into small pieces which are forced into the dried interproximal areas. The other strips are applied on the buccal and lingual surfaces, pressing firmly into place, but being careful not to encroach on the occlusal surfaces. The patient is instructed not to use hot fluids for 10 to 12 hours and not to brush the area. The surgical pack is removed in two weeks. Patients given this treatment should be given an oral prophylaxis every six months.

William A. Peterson

PREVALENCE OF MALOCCLUSION IN CHILDREN AGED 14 TO 18 YEARS

Maury Massler and John M. Frankel. Am. J. Orthodont. 37:751, October, 1951.

Since malocclusion affects a large segment of the population, it is, by definition, a public health problem. As in any other phase of public health work, it is essential to have accurate information on the prevalence and incidence of the condition.

This study was confined to high school students with a complete permanent dentition since it was felt that the evaluation of the status of a mixed dentition could not be made with accuracy. Malocclusion occurring in the mixed dentition is sometimes transitional so that evaluaton might be subject to too great error.

This study was based on the examination of 2,758 children of Morton High School, Cicero, Ill. Their ages ranged from 14 to 18 years. The designation of malocclusion was reserved for those patients in whom the malpositioning of the teeth was sufficiently severe in degree to require orthodontic treatment or for any person having more than 10 malpositioned teeth.

The children came from fairly uniform ethnic stock, primarily Polish and Bulgar. The families were in the upper segment of skilled laborers employed in manufacturing. The com-

munity was a highly industrialized one. The group was above average nutritionally and received good dental care. Gold restorations were commonly seen and a number of the children (107, or 3.9 per cent) were receiving orthodontic treatment.

Ideal occlusion was found in only 3 per cent of the children. Normal occlusion (less than 10 mildly malposed teeth requiring orthodontic correction) was found in 18.2 per cent of the children. This means that, clinically, malocclusion was absent in 21.2 per cent of the children or, conversely, 21.2 per cent of the children had a "good" occlusion which did not require correction.

Malocclusion was present in 78.8 per cent of the children. These children were in need of some form of orthodontic treatment. In most instances, such treatment would require simple measures.

William F. Ford

THE APPLICATION OF ORAL SCREENS TO THE MECHANO-THERAPY OF MAXILLARY PROTRUSION

A. Thornton Taylor. Austral. J. Den. 55: 184, June, 1951.

The oral screen has been used extensively and with success. This appliance has proved valuable as a means of harnessing the muscular power of the lips, of utilizing the potentialities of pressure balances of the upper respiratory mechanism and of eliminating at one step the damaging pressures of the cushioning lower lip. The method of wearing the oral screen is discussed as well as the psychology of the patient and the period of toleration. A detailed and extensive description of the method of preparation is given which includes the taking of impressions. Also included are recommendations for its use in retention.

E. J. Fredrickson

ELECTROSURGICAL GINGIVOPLASTY—A TECHNIC

M. M. Sugarman. J. Periodont. 22:156, July, 1951.

Gingivoplasty, the procedure of obtaining proper gingival architectural form, may be carried out adequately by the use of electrosurgical instruments. The advantages of contouring the gingivae with electrodes rather than with the surgical knife include (1) better vision of the working field; (2) greater accessibility for instruments; (3) absence of instrument pressure; (4) possibility of contouring the tissue by the removal of extremely thin sections and (5) superior bevel on the soft tissue margin. A definite technic has been evolved and this must be followed with certain precautions always in mind. Most of the complications, when encountered, are caused by inexperience or inadequate equipment.

There are relatively few cases in which gingivoplasty is the only periodontal procedure which should be performed. Yet the superior end results achieved by employing electrosurgical gingivoplasty, often in conjunction with subgingival curettage and thorough home care, or less frequently in addition to systemic therapy or occlusal equilibration, are evident and highly desirable.

Alfred Ogilvie

OBSERVATIONS ON THE PHARYNGEAL FLAP OPERATION FOR THE IMPROVEMENT OF SPEECH IN CLEFT PALATE PATIENTS

Fred Squier Dunn. Plast. & Reconst. Surg. 7:530, June, 1951.

The problem of obtaining good speech from the individual born with a cleft palate is a complex one. It involves many factors such as the psychology of the individual, his own interest and desire to speak well, the keenness of his phonetic ear, the training in speech he has received, his ability to reestablish new speech pathways as his case progresses. When surgery provides an oronasal opening which can be opened or closed at will it has accomplished its purpose, but the surgeon's responsibility as guide and director of the patient should not cease until good speech is attained.

The speech results obtained by merely closing a cleft palate were frequently disappointing and puzzling to the men doing this type of surgery. Secondary operations were devised to aid this closure, the most noteworthy being the pushback operation of George Dorrance. For 15 years the author used this on the majority of his cases until he realized that little benefit in speech was derived from the procedure, and that real damage was being done to the development of the superior maxilla, if the operation were done before it attained its full growth, by depriving the palatal bone of its periosteal nourishment and covering it with constricting scar tissue.

In June, 1948, a preliminary report was made before the American Association of Plastic Surgeons in Boston on observations of the pharyngeal flap operation. This was based on 13 cases. Since that time, the author has operated on 17 more patients bringing the

series to 30 cases. Their ages ranged from 8 to 35 years. All but one of these cases have been successful, and speech has been improved

From his experience, the author believes that the pharyngeal flap operation described by Robert E. Moran is the most important surgical contribution thus far presented in aiding speech in those cleft palate patients who have had their palates closed and still do not speak well. This operation makes it possible for them to close their oronasal opening.

In the rehabilitation of these unfortunate people, this operation, coupled with adequate speech training, will go far toward attaining that goal of perfection for which all are striving.

Warren R. Schram

THE EPIDEMIOLOGY OF PERIODONTAL DISEASE

C. D. Marshall-Day. J. Periodont. 22:13, January, 1951.

Although periodontal disease was known 4,000 years ago, there is little reliable information regarding its epidemiology. Periodontal disease constitutes a serious and universal health problem. The literature reveals great differences in prevalence of the disease; for example, Messner reports an incidence in children 6 to 14 years of age of 3.5 to 8.6 per cent while McCall reports a prevalence of 98 per cent. Such differences are due to the lack of agreement in the assessment of gingival disease. The incidence of periodontal disease associated with bone destruction is difficult to obtain because of the limited use of roentgenograms in epidemiologic studies. The available studies give a range of 29.2 per cent to 83 per cent incidence when roentgenograms were used.

Much clinical evidence has been gathered to show oral manifestations of occupational origins but reliable statistics are not available. Habitual neglect, dietary habits (for example, the habits of primitive Eskimos as compared with "civilized" Eskimos), and habitual use of tobacco are cited as having some influence in periodontal disease.

Various studies indicate that the incidence of periodontal disease increases with age, beginning with 6 years of age. An exception to this general pattern is the period between 14 and 18 years during which there seems to be a decline in incidence.

Inasmuch as various regions of the mouth are not uniformly affected by periodontal disease, a single region cannot be used as an index of the mouth condition as a whole. The molar areas and the lower incisor areas have the least resistance to destruction caused by periodontal disease while the bicuspid and upper incisor areas have relatively more.

Available evidence indicates a lower incidence of gingivitis among female children and adolescents and in older age groups a lower incidence of periodontitis and average degree of bone resorption but a comparatively higher incidence of periodontosis in female adults.

Further conclusions regarding the epidemiology of periodontal disease must await the acceptance of the disease as a public health responsibility and the instituting of studies on a broad basis.

William A. Peterson

SOME ASPECTS OF PEDODONTIA RELATIVE TO ORTHODONTIA

Alan S. Burgess. Austral. J. Den. 55:192, June, 1951.

The majority of this discussion relative to preventive orthodontia directly concerns the pedodontist but much is directed to the general practitioner. A seven point program for preventive orthodontia is outlined and each point is discussed at length. A detailed outline of harmful oral habits—sucking, biting, swallowing and breathing—is listed giving the probable sources of the difficulty and suggested therapy for each.

The duties of a pedodontist are summed up in a quotation from Dallas McCauley: "First we would contrive to promote the programme of the pediatrician, to guard over the general physical health of the child during the first twelve or thirteen years of life. Secondly, we would use all possible means to promote the most favourable environment for the growing face and denture. This would include maintaining optimum health of the primary teeth and correction of all local factors known to produce imbalance of developmental forces."

E. J. Fredrickson

CHROME ALLOY IN ORTHODONTICS

Nathan G. Gaston, Am. J. Orthodont. 37:779, October, 1951.

Stainless steel, or, as it is now more generally called, chrome alloy, has numerous desirable qualities that have been recognized from the beginning. Its hardness, its high tensile strength, even in small wires, and especially its extreme resistance to corrosion and discoloration have had a great deal to do with its adoption as an orthodontic appliance material. However great these beneficial effects

may be, the use of the material was almost abandoned in the early days because of the extreme difficulty in manipulating and fabricating the various parts into a whole. This difficulty revolved around the seemingly impossible task of joining the various pieces together, the usual fluxes not being adequate.

Chrome alloy may be used for any type of appliance in orthodontics today. Spot welding (a form of electrical resistance welding) is accomplished by holding the pieces to be welded together between hard copper electrodes under pressure and passing a high-amperage current through them for a definite period of time.

Adoption of the technic outlined will assure the user of a simple and expedient application of chrome alloy in orthodontic appliance construction with the assurance that all fabrications are neat, strong and durable. This technic makes possible the use of this alloy which shows so many definite advantages over other orthodontic materials.

William F. Ford

THE SENSE OF DENTAL AND LABIAL ARTICULATION IN ORTHODONTIC TREATMENT

Clifford G. Glaser. Am. J. Orthodont. 37:565, August, 1951.

A primary factor controlling normal development of the facial pattern and the tooth occlusion is incisal biting. Frequent ingestion of liquids does not necessitate incisal biting for in the act of swallowing liquids, the teeth are apart. The teeth are tightly clenched only when swallowing foods which require previous mastication. Sloppy speech habits and lack of nasal breathing both have a similar perverted effect on normal facial muscle equilibrium. The potential for normal facial development exists in most cases, but it reaches its maximum only when normal function provides the necessary stimulation.

A few well illustrated Angle Class II, division 1 cases of malocclusion are examined. The upper and lower median lines are eccentric until the patient bites incisally. In addition to the use of intermaxillary elastics in treatment, fluids are allowed only before or after meals, and patients are told to chew on a wooden blade with their incisors for 15 minutes every morning and night. A bite plate appliance is used to force the lower incisors to bite just posterior to the uppers by means of an inclined plane which the author calls an incisal guide lock. A muscle exercise is utilized in conjunction with the incisal guide lock whereby water is forced from the lingual to the labial and buccal sides of the teeth, while the teeth are tightly occluded.

Final success in orthodontic treatment depends on utilization of the normal functions of the mouth and facial musculature.

Morton Heide

THE CAST CORE ACRYLIC POST CROWN

F. E. Lawton and G. E. Myers. Brit. D. J. 91:181, October 2, 1951.

A great many acrylic resin post crowns fail at the junction of the metal and acrylic resin because of the discrepancy in size of the crown and the prefabricated post to which it is attached. By using a cast gold core, with the crown portion of greater size than customary prefabricated posts, fracture at the metal and acrylic junction is minimized.

The root canal is filled and the root prepared in the orthodox manner. The impression of the root canal is accomplished by using 1 mm. diameter wire tapered approximately to fit the canal. The root canal is lubricated with soap solution. Wax is melted on to the wire, carried to place, and carved to the shape of a jacket crown preparation. Two small retention lugs are waxed at the mesioincisal and distoincisal angles.

The cast core is inserted into the root. A copper band, properly festooned to fit the preparation, then is filled with compound and carried to place. A sectional impression is taken including the adjacent teeth, with the copper band in place.

A silicophosphate cement die is made, the root end is tapered, and with the copper band still in place, it is inserted into the sectional impression and the stone model is poured. Following this, the die is removed from the stone model and the copper band impression is removed from the die.

The die then is replaced in the stone model and the crown is carved in wax and processed directly on to the core.

Monte G. Miska

INDUSTRIAL DENTAL HEALTH PROGRAM SPONSORED BY THE COOPERATIVE SERVICE, WYOMISSING, PENNSYLVANIA

H. H. Dougherty, D.D.S., Ind. Med. & Surg. 20:408, September, 1951.

An industrial dental health program in effective use today in the Wyomissing Industries is described. The plan includes preemployment examination as well as periodic examinations

later. In addition to prophylaxis, emergency treatment is also offered. Integrated into the system is an over-all dental educational program. The findings are discussed with the patients and a referral system is used, utilizing the family dentist to complete the oral rehabilitation.

Morton Heide

TREATMENT OF INJURIES TO ANTERIOR TEETH

C. Cooke and T. C. Rowbotham. Brit. D. J. 91:146, September, 1951.

Experience at the Dental Hospital of Manchester shows the majority of injuries to anterior teeth occur to children under 15 years of age.

Immediate treatment is desirable. At the first visit, and in all cases, the routine procedure should be as follows: (1) Full case history and assessment of the damage to the tooth is recorded. (2) Treatment of damage to soft tissues is carried out, including prescription of mouthwashes if considered necessary. (3) Roentgenograms are taken of all teeth in the affected area to obtain evidence of fracture of the root, fracture of the alveolar process, displacement of tooth, size of the pulp chamber and degree of calcification of the root. (4) The pulpal response of the affected tooth should be ascertained and compared with that of adjacent teeth.

Although presenting an infinite variety of clinical features, all types of trauma to anterior teeth fall into one of four classes: teeth where there is no loss of tooth substance or fracture of root; those with fracture of crown without exposure of pulp; those with fracture of crown with exposure of pulp, and, finally, those with fracture of the root, with or without fracture of the crown.

Each of these classes are discussed and recommended treatment is included for each of the classes.

W. W. Demeritt

PUBLIC HEALTH ASPECTS OF WATER FLUORIDATION

Herman E. Hilleboe and David B. Ast. Am. J. Pub. Health 41:1370, November, 1951.

The most spectacular success in the past fifty years in the field of public health has been the reduction of some water-borne communicable diseases. This was accomplished through the simple expedient of the introduction of a harmless chemical into the public drinking water supply. This is the most successful public health method for the control of a disease since it is inexpensive, automatic and does not require individual participaton. Public health organizations have been unable to supply such a method to any of the so-called chronic diseases such as cancer, heart disease or dental caries. It is therefore with much satisfaction that the health officer is reviewing the significant progress made in dental caries prophylaxis by the simple and economical expedient of the introduction of nontoxic amounts of fluorine salts into public drinking water supplies. This procedure is identical in principle with the chlorination of drinking water for the reducton, almost to the point of elimination, of water-borne typhoid fever.

The progress made in water fluoridation is outlined from both the technical and administrative standpoint. Also, the manner in which this dental caries control measure can be successfully introduced and maintained by public health agencies in all fluoride free public drinking water systems.

Frank C. Cady

JOURNAL OF ORAL SURGERY
October 1951

EOSINOPHILIC GRANULOMA OF BONE

Myron Kaufman, p. 273.

Various vague conjectures have been made as to the etiology of eosinophilic granuloma of bone but none have been substantiated. The lesion characterizing the disease usually is seen in children and adolescents, and occasionally in young adults. Any bone can be the site of a lesion in the single or multiple manifestations of the disease. Systemic complaints are absent in most instances of this disease. If the involved bone is superficial, swelling may be the first symptom. Local tenderness and pain are common symptoms. The lesion appears as a radiolucent zone, more or less circular, sharply demarcated, giving a "punched-out" effect to the bone. The disease appears to have a predilection for the hemopoietic system since the lesions seem to represent an inflammatory reaction to some unknown infectious agent with the resultant basic cell production of large numbers of histiocytes. Laboratory findings are entirely unrevealing. The lesions heal readily after simple curettage even without supplementary roentgen irradiation of the site and may even heal by resolution without any form of therapeutic treatment. Prognosis is excellent and healing is rather prompt, particularly in cases with solitary lesions.

MANAGEMENT OF IMPACTED MAXILLARY THIRD MOLARS

Irvin V. Uhler, p. 281.

A first requisite in the management of impacted maxillary third molars is careful roentgenographic examination revealing the entire tooth with the bone in its immediate environment. The flap is made as follows: The mucoperiosteum over the first molar site just short of the mucobuccal fold is entered with a scalpel. The incision is carried downward and backward through the interproximal septum separating the first and second molar teeth. From this point the incision is carried along the buccogingival margin around to the distolingual aspect of the second molar tooth, and distally over the tuberosity, stopping just short of the junction of the tuberosity and the pyramidal process. The next step is removal of buccal and occlusal bone overlying the crown of the tooth. To remove the tooth, interpose a thin elevator between the crown and the buccal alveolar bone. In the event of distal curvature of the roots, a sharp pointed elevator may be interposed between the cementoenamel junction of the impacted tooth and the mesial bone septum. This region presents a most delicate bony structure and any gouging and forcing pressure may lead to complications. During luxation of the tooth, the cause of the slightest resistance or impingement must be sought out and removed, but should never be overcome with elevator force.

BLOCKING THE MANDIBULAR NERVE AT THE FORAMEN OVALE

Ernest G. Sloman and H. Patrick Donnelly, p. 283.

Variation in sizes of skulls accounts for the majority of difficulties and failures reported in blocking the mandibular nerve at the foramen ovale. Rarely, however, is there any consequential asymmetry of skulls (1) in distances of foramina ovalia from each other and from each foramen ovale to the closest skin surface; (2) in the relationship of each of these measurements to over-all skull width. An examination of 240 skulls of diverse ethnic origin was made and the details were recorded to determine their widths at points corresponding to a horizontal straight line passing immediately below the foramina ovalia and laterally to the closest skin surfaces. The width of the face is measured with calipers and the determined width is recorded and divided by three. The measurement—that is, one-third of the total caliper measurement—is now marked on a 22 or 24 gage Leur type needle to be used for the injection. One end of an orangewood applicator, 3 or 4 cm. long, is wrapped with cotton, and that end is so placed in the external acoustic meatus that the other end points horizontally outwards. A dot is placed 3 cm. directly forward of the orangewood stick. This is the place selected for injection. It should be about 3 cm. in front of the center of the external acoustic meatus; 1 cm. below the widest part of the head; 1 cm. in front of the lowest point of the eminentia articularis and, therefore, 1 cm. in front of the most direct approach to the mandibular nerve at a position corresponding to about 6 mm. below the foramen ovale; just below the center of the prearticular notch; at about the middle of the mandibular notch. The needle is directed horizontally toward the sagittal plane, with a backward inclination of about 12 degrees. The needle point thus passes horizontally medially for one-third of the width of the head and posteriorly to the extent of 1 cm. Because the face becomes narrower from the point of injection forward, there is an inclination to direct the needle point too far posteriorly; that is, at an angle greater than 12 degrees. If inserted at nearly right angles to the skin surface of the face, the needle will go nearly directly to the foramen.

COOPERATION OF ORAL SURGEON AND PROSTHODONTIST IN RENDERING ARTIFICIAL DENTURE SERVICE

Luzerne G. Jordan, p. 292.

There is one feature of dental service which has been given too little attention, both in clinical and private practice. This pertains to the dental examination and the formulation of treatment plans for patients who will need artificial denture service. In too many instances natural teeth are extracted without the patient being informed of the procedure which should be followed. A complete understanding on the part of the patient regarding the nature of artificial dentures and their many shortcomings, previous to the loss of his natural teeth, is one of the most important factors in the attainment of a successful end result. Preextraction records constitute one of the best aids to the rendering of artificial denture service. Alveolectomy is not necessary in all cases and should be avoided when possible. Except in case of disease or injury the only reason for altering edentulous ridge form is to meet the requirements of prosthetics and the prosthodontist is best qualified to prescribe such alteration. It is the responsibility of the prosthodontist to furnish the oral surgeon with

whatever guides may be necessary to enable him to form a ridge which will fit the denture. Surgical procedures, which may involve the use of sutures, should therefore be designed to preserve the maximum normal depth of the buccal and labial sulci, especially in immediate denture service.

CYSTS OF THE JAW BONES

James L. Bradley, p. 295.

During an extensive hospital practice in oral surgery many ramifications of cystic conditions of the jaw bones may present themselves for diagnosis and treatment. One of the problems in diagnosis in oral surgery, is to differentiate oral cysts from the numerous groups of neoplastic processes which appear as cysts roentgenographically. Ameloblastoma which is derived from epithelium of the enamel organ type that does not actually form enamel is the most common. The characteristics of cysts are slow growth, gradual osteolysis, which forms a definite cavitation, and eventual expansion of bone. In a preoperative study of any cystic lesion possible neoplastic lesions of bone must be considered. It is important to record facts regarding previous illnesses and particularly those which give rise to bone lesions; for example, syphilis, osteomyelitis, actinomycosis and any previously treated malignant disease of any organ or system. The roentgenogram is the important factor in a preoperative differential diagnosis of various cystic lesions. The roentgen findings of a cystic region are usually characteristic; a radiolucent area, with a definite, even radiopaque line at the periphery, can be seen. This represents the compact layer of bone which surrounds the cyst membrane. In combination with roentgen examination an aspiration biopsy, surgical biopsy, or injection of a radiopaque substance may be used for differential diagnosis. The treatment of choice for cysts is surgical excision. The relative location of a cystic lesion to other structures, such as teeth, maxillary sinus, nasal and orbital cavity, mandibular canal and adjacent soft tissue, must be taken into consideration when determining treatment. Extraction of teeth may be necessary; however, an apparently nonvital tooth may again respond to vitality tests after excision of the cyst. Condemned teeth may temporarily be left in position to act as a supporting structure during the healing period. A Caldwell-Luc operation is indicated for cysts that encroach on or extend into the maxillary sinus. Marsupialization, or the Partsch operation, is indicated for large cysts in which surgical removal would cause extensive mutilation or deformity. Every specimen of cystic tissue removed should be submitted for pathological study to verify the diagnosis. This is essential in connection with the marsupialization technic, because neoplastic tissue would require a more radical operation.

AN AUTOMATIC VERTICAL ANGULATION METER FOR PERIAPICAL AND OCCLUSAL ROENTGENOGRAPHY

Albert G. Richards, p. 309.

Since the advent of dental roentgenography, many methods and devices have been contrived to furnish information about vertical angulation. The theory on which this new vertical angulation meter is based is explained. With the aid of the meter, production of periapical roentgenograms is accomplished in three easy steps. (1) The meter is held in a vertical position near the patient's mouth with the edge of the case visually aligned with the plane of the film packet and the movable arm of the meter aligned parallel to the long axis of the tooth under investigation. The reading of the meter then is noted. (2) The x-ray unit is adjusted in accordance with the information given by the meter. (3) The central ray of the x-ray beam is directed at the gingival margin of the tooth and the exposure of the film is completed. No longer is a standard head position necessary when the meter is utilized. The patient could be in a supine position or seated upright in a chair and the proper vertical angulation would be indicated in each case. The vertical angulation values indicated by the meter will yield correct tooth length when the central ray of the x-ray beam is directed at the gingival margin of the tooth. The meter is as valuable for occlusal roentgenograms as it is for periapical views. The meter has been in use and tested for six years and has proved to be a valuable substitute for experience and a time saver in eliminating the prevalent need for retakes.

ANESTHESIA FOR OFFICE ORAL SURGERY WITH A CLINICAL EVALUATION OF THIAMYLAL SODIUM

Harry M. Seldin, p. 314.

In prolonged office oral surgery thiamylal sodium, 0.4 per cent, or thiopental sodium, 0.4 per cent, by continuous intravenous drip, plus nitrous oxide, with a minimum of 50 per cent oxygen, is the anesthetic of choice. Thiamylal sodium is a new intravenous anesthetic agent. Rovenstine and associates have used it in over 6,000 hospital anesthesias and have found it

to produce an excellent anesthesia. It is about 1.5 times as potent as thiopental and consequently smaller doses are required. Induction is accomplished by slow, intermittent injection of 1 cc. fractions of thiamylal, or by continuous intravenous drip. Anesthesia is maintained with nitrous oxide-oxygen and fractional doses of 1 cc. thiamylal as indicated. Oxygen percentages of at least 50 per cent are used. Barbiturates are contraindicated in asthmatic patients and their use is precluded in extensive swelling and infection of the floor of the mouth and neck. Burstein has shown that intravenous procaine hydrochloride reduces the acute arrhythmias during anesthesia. For cardiac standstill 1 cc. of 1:1,000 dilution of epinephrine administered intravenously or directly into the heart is indicated.

CHONDROMYXOSARCOMA OF THE MANDIBLE

John K. Paul, p. 319.

Chondromyxosarcoma is a bone tumor rarely found in the region of the head and neck. Chondromyxosarcoma is usually a slow growing neoplasm and the correct early diagnosis resides in its relative amenability in accessible sites. Two distinct varieties of the tumor are recognized, the peripheral and the central types. The persistence of connective tissue of the embryonic precartilaginous type in benign tumors provides the origin of chondrosarcoma, which is superimposed on the original benign growth. The majority of chondrosarcomas have a cartilaginous origin, arising from pre-existing chondromatous tumors, whereas osteogenic sarcomas originate from primitive bone-forming mesenchyme. Chondrosarcoma occurs most frequently in the long tubular bones of the limbs, the innominate bones of the pelvis and the ribs, and rarely in the jaw. A long clinical history is typical, ranging from 2 to 20 years. The most striking clinical sign is the disfigurement that results as the lesion progresses in size. Pathologic fracture rarely occurs. A roentgenogram of a bone presenting an irregularly mottled and calcified shadow in its interior and a fuzzy area of localized destruction of the cortex should suggest the possibility of a chondrosarcoma. Radical resection is the only treatment for chondrosarcoma that offers any prospect of cure. The wider the margin of supposedly normal tissue the better will be the prognosis. The lesion is radioresistant. If intensive radiation is instituted first and then followed by surgical intervention, the picture will be greatly complicated. The bone will undergo radionecrosis accompanied by soft tissue destruction in the region, with ensuing secondary infection. Chondrosarcoma (peripheral or central) is likely to remain only locally invasive for years, even if left entirely alone. Metastasis usually occurs late in the disease, which is in contrast to the osteogenic sarcoma which spreads early. It occurs by invasion of the veins followed by circulatory spread. Prognosis is better than for osteogenic sarcoma since the chondrosarcoma usually has not metastasized at the time of initial surgical intervention. The ultimate result is not good with chondrosarcoma of the jaw. The prognosis is definitely better if the case is an early lesion and the operation aggressive. A case report of a chondromyxosarcoma of the mandible is presented. It probably represents the central variety of the tumor since the cortex was mainly intact. The tumor is slow growing and has had no obvious recurrence in 5 months.

JOURNAL OF DENTAL RESEARCH
December 1951

THE EFFECTS OF AN ACID AND A NEUTRAL SOLUTION OF SODIUM FLUORIDE ON THE INCIDENCE OF DENTAL CARIES IN YOUNG ADULTS

Norman H. Rickles and Hermann Becks, p. 757.

The effectiveness of two 2 per cent sodium fluoride solutions, with sodium lauryl sulfate incorporated as a wetting agent, was tested for their abilities to reduce the incidence of dental caries in young adults. The solutions tested were identical in all respects, except that one was at a pH of 7, while the other was at a pH of 3.5. Twenty-five students were used to evaluate the effectiveness of the neutral solution, while 22 comprised the group testing the acid solution. In each group the teeth on one side of the mouth were treated with a series of four applications of the indicated solution, with the teeth on the other side serving as controls. The group using the solution at a pH of 7 developed 48 new carious surfaces in the treated teeth after an observation period of two years, where there had been 264 open lesions at the outset of the experiment. Eighty new lesions developed in the untreated teeth where 266 open lesions had been in existence at the beginning of the experiment. The difference in the two percentages—18 per cent and 30 per cent—was highly significant. This may be interpreted as meaning that the 2 per cent sodium fluoride solution at a pH of 7, with a wetting agent added, is capable of significantly reducing the

total caries increment in young adults. Similarly significant results were obtained in the special cases of interproximal and secondary caries. Using the solution at a pH of 3.5, no reduction of caries increment occurred in any category.

BACTERIOLOGIC STUDIES OF THE ADVANCING DENTINAL LESION

George W. Burnett and Henry W. Scherp, p. 766.

In view of the confusion regarding the nature of the bacterial flora of the advanced region of caries in dentin, it has been difficult to define the reactions that produce the lesion in this tissue. A bacteriologic study of the advancing carious front in dentin showed that only three groups of microorganisms (cocci, lactobacilli, and actinomyces) could be isolated regularly. More than 90 per cent of the cultivable bacteria were gram-positive cocci, half of which were caseinolytic but none were active against more resistant proteins such as decalcified dentin. The cocci were composed of enterococci and micrococci. Lactobacilli made up 5 per cent of the cultivable bacteria. The various strains were nearly homogeneous in their reaction, but were not identical with any described species. Anaerobic filamentous microorganisms were isolated regularly. The characteristics of these microorganisms were homogeneous and typical of the genus Actinomyces, although they did not agree exactly with any defined species. The actinomyces acted on dentin to produce a dark-brown pigment, resembling that often seen in natural caries. No pigment was produced from other protein. The role of the three groups of microorganisms in dental caries is discussed.

HAMSTER CARIES: THE EFFECTS OF THREE DIFFERENT DIETARY SUGAR LEVELS AND AN EVALUATION OF SCORING PROCEDURES

David F. Mitchell, D. S. Chernausek and Edith Zak Helman, p. 778.

In view of the high cariogenic potential of sucrose, it was desirable to evaluate the effects of different percentages of sucrose in a caries-producing diet. Three groups of hamsters, distributed according to sex and littermates, were fed a caries-producing diet containing 15 per cent, 30 per cent and 45 per cent sucrose.

Although the 45 per cent dietary sugar level was associated with more caries than the 30 or 15 per cent levels, no significant difference was found between the groups.

A definite sex difference in regard to caries; that is, more caries experienced by the males, was shown to exist in these animals and, therefore, the grouping of the two sexes for mathematical purposes should not be encouraged. A simplified method for scoring of hamster caries is offered in which only the occlusal area affected is considered for evaluating caries experience.

SYMPATHICOTONY OF THE SALIVARY GLANDS AS A CAUSE OF DENTAL CARIES

Werner Rathje, p. 783.

EFFECTS OF IONIZING RADIATION OF ORAL STRUCTURES. I. PILOT STUDIES ON DENTAL CARIES IN THE WHITE RAT

C. A. Schlack and F. Ellinger, p. 787.

A pilot study involving caries susceptible rats of the Naval Medical Research Institute strain kept on a cariogenic and Purina Laboratory Chow dietary regimen and exposed at the age of three weeks to 200 r (HVL =0.75 mm. Cu.) given as total body radiation in a single exposure is reported.

The following results were obtained: (1) In the group of irradiated animals kept on the cariogenic dietary regimen, a statistically significant increase of dental caries incidence was found, as compared to the unirradiated controls; (2) in the group of irradiated animals kept on Purina Laboratory Chow, no such results were obtained; (3) the analysis of the weight curves indicates a lesser gain of body weight in the irradiated animals irrespective of the dietary regimen.

A HISTOCHEMICAL EVALUATION OF NORMAL AND INFLAMED HUMAN GINGIVAE

Samuel Turesky, Irving Glickman and Tamara Litwin, p. 792.

A histochemical study was undertaken to evaluate the structures of normal gingiva and the changes to which they were subject in the course of chronic inflammation. The material consisted of 22 specimens of normal and inflamed human gingiva from 17 men and women ranging from 21 to 54 years of age. The tissues were examined using the Lillie and Hotchkiss leucofuchsin periodic acid methods for the study of ground substance, basement membrane and glycogen; and the Gomori technic for the study of alkaline phosphatase.

Each specimen also was examined using the hematoxylin and eosin technic and was subjected to control study for the presence of free aldehydes, free iodates and periodates and preformed mineral deposits. Comparison of the normal and inflamed gingivae revealed reduction in connective tissue glycogen and ground substance and thinning out of the basement membrane in chronic gingivitis. Alkaline phosphatase which was present in the endothelial cells of the scattered capillaries in the normal gingiva appeared concentrated in the inflammatory cells, fibrocytes, endothelial cells and collagen fibers in the areas of gingival inflammation. In zones of chronic inflammation, hyperplastic epithelium showed an increased intracellular accumulation of glycogen.

IN VITRO SENSITIVITY OF FUSOBACTERIA TO VARIOUS ANTIBIOTICS

Robert R. Omata, p. 799.

The inhibitory action of various antibiotics was assayed for seven strains of Fusobacteria. The tests were carried out *in vitro,* using Brewer's fluid thioglycollate medium. It was found that penicillin G, terramycin, aureomycin, tyrothricin and chloramphenicol, in that order, were most effective in inhibiting the growth of Fusobacteria. These organisms showed resistance to dihydrostreptomycin and streptomycin.

TWO STUDIES OF PERIODONTAL DISEASE IN THE SYRIAN HAMSTER

David F. Mitchell and D. S. Chernausek, p. 802.

The effect of ammoniated products on periodontal disease was studied. Four groups of animals, totaling 103, were maintained 100 days on a soft, high carbohydrate diet. The groups were divided as follows: Group I, control; Group II, daily toothbrushing with control dentifrice; Group III, daily brushing with ammoniated dentifrice; Group IV, ad lib ingestion of ammoniated products in diet. Significant reduction of periodontal disease was observed in Group III and Group IV over Group I and Group II. Three groups, about 54 animals each, distributed according to sex and littermates, received respectively 15, 30, and 45 per cent sucrose in their diets. No significant difference in periodontal disease scores was noted. Comparisons of the two studies were made. The scoring method proved definitive, and no sex difference in susceptibility was established.

DENTAL DISEASE IN PSYCHIATRIC PATIENTS

J. M. Dunning, R. B. Hyde and Peter Dalton, p. 806.

A group of 2,212 in-patients at the Boston Psychopathic Hospital between the ages of 10 and 50 years were studied for possible relationships between mental state and dental disease, the latter expressed in terms of DMF teeth. This group of patients as a whole shows a somewhat lower DMF rate than was found by Hyde among Boston military selectees in 1943 and a considerably lower DMF rate than was found by Dunning and Klein among industrial employees in New York City in 1942. Since these differences may be regional or be due to differences in examination methods, and since the hospital group showed a wide range of mental states, it was decided to use this group as its own base line. For purposes of analysis the sample was divided into five-year age groups. Few mental diagnostic groups showed any significant difference from the DMF rates for the sample as a whole. The differences which were found were small.

Patients with manic-depressive psychosis had a higher DMF rate at every age studied, although the differences were so small and the number of cases in the samples were so small that statistical significance was only obtained by a small margin when the series was considered as a whole. Patients 30 to 40 years of age showing alcoholism (without psychosis) also had a higher DMF rate accompanied by a higher tooth mortality (M teeth).

Further study of larger groups and more groups with chronic mental disease is desirable.

THE DENTITION AS A CRITERION OF RACE WITH SPECIAL REFERENCE TO THE ALEUT

C. F. A. Moorrees, p. 815.

Advantages of the dental study in man are: to establish possible linkage in time and space between populations; to differentiate within populations; to study the influence of admixture; to determine the mode of inheritance; to add to the body of data concerning the dentition.

Data on the Aleut may illustrate some of these points. Morphologic and linguistic differences found in this population are supported by the dental study. Torus mandibularis was present in 61 per cent of Eastern Aleuts (those living east of Atka) against 26 per cent (critical rates 3.4) in Western Aleuts (living in

Atka and formerly Attu). Mandibular prognathism occurred only in the Eastern populace (13 per cent, critical ratio 2.2). The numerous other differences are not statistically valid, partially because of the small numbers.

Available data suggest strongly that torus mandibularis depends on genetic rather than functional factors for its presence. The incidence of mandibular prognathism is dependent on a single recessive gene in this populace. Mesiodistal tooth diameters can be used as one example illustrating variations within the Mongoloid race.

Variations of primary racial features of the dentition within sub-races should be studied attentively since pure Mongoloids, for instance, do not exist.

The ultimate value of the dentition as a criterion of race will depend on the outcome of detailed studies in populations of known racial origin.

DOLORIMETRIC EVALUATION OF DENTAL PATIENTS

A. H. Kutscher and N. W. Chilton, p. 822.

One hundred and sixty-eight untrained dental patients were included in this study. These patients, 56 men and 112 women, aged 10 to 60, were oriented in the use of the Hardy-Wolff-Goodell pain threshold apparatus (Dolorimeter) and their pain thresholds were determined by the Hardy-Wolff-Goodell technic. The range of the human pain threshold and also its relation to reaction to pain, fear of pain, and the individual's estimate of his own pain threshold were studied.

Pain threshold of the 168 untrained subjects ranged from 178 millicalories to 350 millicalories with a median value of 223.5 millicalories and a mean value of 231 millicalories. The quartile range was from 202 millicalories to 253 millicalories.

It was concluded that the spread of the individual pain threshold determinations indicates such a lack of uniformity of the pain threshold in man with respect to radiant heat pain stimuli as to be of definite clinical importance. It was evident also that radiant heat stimuli of different intensities will produce varying sensations in different individuals, depending on their original pain threshold.

It was not possible to relate the pain threshold as determined by radiant heat stimuli with patients' reaction to pain, fear of pain, or the individual's estimate of his own pain threshold as derived from dental procedures.

STUDIES ON THE PHYSICAL PROPERTIES OF RODENT ENAMEL. II. DENSITY DISTRIBUTION AND X-RAY DIFFRACTION PATTERN

J. Edward Gilda, p. 828.

A method was devised for the determination of density distribution of small amounts (80 mg.) of powdered calcified tissues. It employed a modified Manly-Hodge separation tube in which successive fractionation of the same sample was performed at different densities. Albino rat molar enamel had a density between 2.720 and 2.920 grams per cubic centimeter with a single maximum in the region of 2.90. The distribution was somewhat different from that reported for human deciduous and permanent enamel.

X-ray powder diffraction analysis demonstrated that the mineral salt in rodent molar enamel closely resembles hydroxylapatite. As a consequence of this, density differences between rat and human tissues were attributed to a relatively greater amount of organic material in rat enamel.

DENTINAL PROTEIN: BOUND CHOLESTEROL

R. S. Leopold, W. C. Hess and W. J. Carter, p. 837.

Hydrolysis (acidic and basic) and alcoholysis (ethanol) of ground dentin are compared as to percentage of yield of cholesterol and cholesterol esters obtained on extraction. Demineralization alone is not sufficient to free cholesterol; it is necessary that at least a portion of the dentinal protein be hydrolyzed. Normal dentin from the roots of extracted, sound third molars yielded approximately 22 to 24 mg. cholesterol and its esters per 100 Gm. of starting material.

DENTINAL PROTEIN: SOME EFFECTS OF PRESERVATIVES

W. J. Carter, R. S. Leopold and W. C. Hess, p. 840.

Sound, normal, upper and lower third molar human teeth were preserved in solutions of alcohol, chloroform, and formaldehyde. A comparison of methods of preservation of teeth using quick freezing as a standard was made. The factors considered were protein recovery, nitrogen analysis and gross microscopic appearance of recovered protein.

Evidence of denaturation was found, particularly with formaldehyde. Chemical changes brought out by nitrogen analysis were not

significant indicating that while a heterogeneous group of teeth will contain a fairly constant amount of nitrogenous materials they may be chemically altered.

PHYSICAL PROPERTIES OF AMALGAM AS INFLUENCED BY VARIATION IN SURFACE AREA OF THE ALLOY PARTICLES

Walter S. Crowell and Ralph W. Phillips, p. 845.

The physical properties of an amalgam alloy having particles of varying specific surface have been studied. The specific surface was controlled by varying the thickness of the chip.

Data show that the properties of chips, of a given thickness, cut from different areas of the same mold, will vary. When tests were made on cuttings of varying thicknesses from adjoining areas of the ingot, it was found that the expansion is a linear function of the surface area. When the setting time is plotted against the reciprocal of the relative surface area, the curve approaches a straight line.

The greater the surface area, the higher is the compressive strength. The flow remains constant except for the thickest cuttings here tested which, of course, have the lowest specific surface. The flow on this sample was over 1 per cent higher than on the others.

One hour compressive strength, as might be expected from the setting time data, increases as specific surface increases. Twenty-four hour strength shows a similar trend, although the percentage of difference between the lowest and highest values is only 12 per cent.

CUTTING EFFICIENCY OF DENTAL BURS UTILIZING A STRAIGHT HANDPIECE

E. E. Henry and F. A. Peyton, p. 854.

The ideal cutting instrument for restorative dentistry has been described as one which will remove the most material with the least expenditure of energy, the least vibration, and the least heat introduction, while having the longest life. The present study of dental bur cutting efficiency shows the amount of material removed as a function of pressure (one quarter pound to 1.65 pounds) and speed (from low values to 8,000 rpm). From this data is developed a graphical three dimensional surface with the above quantities as coordinates. The torque and energy required for the operation of the handpiece, alone and during cutting operations, are also shown. The data for the above are obtained through the use of a motor which has been electromechanically calibrated. These data have been gathered for the no. 557 and no. 558 fissure burs, and the no. 37 and no. 39 inverted cone burs. Data also have been collected substantiating previous recommendations that diamond points and stones generally are not indicated for use on soft materials.

LEVO-ARTERENOL (LEVOPHED) AS A VASOCONSTRICTOR IN LOCAL ANESTHETIC SOLUTIONS

Sidney Epstein, Albert H. Throndson and J. Leonard Schmitz, p. 870.

FACTORS AFFECTING MASTICATORY PERFORMANCE AND EFFICIENCY AMONG YOUNG ADULTS

Richard S. Manley, p. 874.

The masticatory performance of 103 persons was determined on the right and left halves of their dentitions, using peanuts and carrots as test foods. Masticatory efficiency was determined for 54 half dentitions. These function measurements were compared with the food platform area, tooth units in occlusion, and the mesiodistal length of molar imprints for the same half dentitions.

Masticatory performance was correlated with all three variables but in a nonlinear manner. Masticatory efficiency was well correlated with food platform area, in a linear manner; less well related to molar imprint length and poorly related to tooth units. A prediction equation was worked out for performance and efficiency from area and molar imprint length. This predicted efficiency agreed with the actual efficiency with a correlation coefficient of 0.90.

Apparently the food platform area and the size of molars are the most important determinants for chewing ability among adults with a normal or defective natural dentition.

Deaths

Anthony, Francis E., St. Louis; Dental Department, Meharry Medical College, 1920; died January 30; aged 57.

Atkinson, Albert E., Buffalo; School of Dentistry, University of Buffalo, 1905; died February 12; aged 76.

Barber, Walter C., Downers Grove, Ill.; Dental School, Northwestern University, 1899; died December 20; aged 78.

Benedict, James H., Hoquiam, Wash.; Chicago College of Dental Surgery, Loyola University, 1900; died January 30; aged 80.

Biel, Henry M., Cleveland; School of Dentistry, Western Reserve University, 1918; died January 1; aged 54.

Blakeman, Robert I., Indianapolis; Indiana Dental College, 1889; died January 15; aged 84.

Bolden, Otis R., Sacramento, Calif.; College of Dentistry, University of California, 1928; died January 14; aged 49.

Boyers, Arthur L., Morgantown, W. Va.; Baltimore College of Dental Surgery, 1897; died January 2; aged 79.

Brooks, William B., Chattanooga, Tenn.; Atlanta Dental College, 1916; died December 27; aged 61.

Brown, Harry C., Bloomington, Ill.; Ohio College of Dental Surgery, University of Cincinnati, 1900; died December 16.

Browne, Roy E., Baldwin Park, Calif.; College of Physicians and Surgeons, San Francisco, 1923; died January 29.

Brumbaugh, Burt B., Brockway, Pa.; Baltimore College of Dental Surgery, 1892; died January 13; aged 85.

Burch, Arthur H., Kalispell, Mont.; died January 27.

Burke, Robert R., Mattoon, Ill.; Dental School, Northwestern University, 1918; died December 25.

Burns, Gerald G., Rochester, N. Y.; School of Dentistry, University of Buffalo, 1895; died February 16; aged 78.

Cannon, James T., Media, Pa.; School of Dentistry, University of Pennsylvania, 1911; died January 8; aged 61.

Christiansen, John F., Los Angeles; Dental School, Northwestern University, 1906; died January 15; aged 76.

Clarke, Arthur G., Oakland, Calif.; Western Dental College, Kansas City, 1908; died February 13; aged 65.

Conard, William T., Philadelphia; School of Dentistry, University of Pennsylvania, 1899; died January 13.

Covey, Wilbur C., Bagley, Minn.; College of Dentistry, University of Minnesota, 1916; died January 24; aged 61.

Danes, Louis R., Des Moines, Iowa; Kansas City Dental College, 1902; died January 9; aged 76.

Delaney, Marlin L., Gloversville, N. Y.; School of Dentistry, St. Louis University, 1946; died January 15; aged 32.

Demarest, Obadiah A., Holyoke, Mass.; Dental School, Tufts College, 1916; died February 16.

Dennis, John J., San Francisco; College of Physicians and Surgeons, San Francisco, 1917; died February 6; aged 60.

Doyle, Gerald F., Cleveland; School of Dentistry, Western Reserve University, 1903; died February 13; aged 70.

Eccles, Robert J., Pleasantville, N. J.; Pennsylvania College of Dental Surgery, 1896; died January 3.

Emery, William G., Fostoria, Ohio; Ohio College of Dental Surgery, University of Cincinnati, 1901; died February 11.

Evans, Phillip S., St. Anthony, Idaho; Dental School, Northwestern University, 1923; died January 25; aged 57.

Fendler, Max, St. Louis; Missouri Dental College, St. Louis, 1896; died January 3; aged 76.

Gallagher, Thomas A., Wilkes-Barre, Pa.; School of Dentistry, Temple University, 1925; died January 28; aged 56.

Ganzburg, Abraham G., Lynn, Mass.; Baltimore College of Dental Surgery, University of Maryland, 1909; died January 7.

Gibson, Clifford A., Carthage, Mo.; Kansas City-Western Dental College, 1933; died December 15; aged 42.

Graves, Frederick P., Saco, Maine; Dental School, Harvard University, 1888; died February 2; aged 86.

Hance, Meade J., Minneapolis; College of Dentistry, University of Minnesota, 1914; died January 9; aged 62.

Harris, Chester F., Fort Worth; State Dental College, Dallas, 1910; died January 22.

Harrison, John W., Altadena, Calif; College of Dentistry, University of Southern California, 1924; died February 10; aged 55.

Hicks, Frank F., Clinton, S. C.; Atlanta-Southern Dental College, 1926; died January 30; aged 52.

Hill, Ambrose L., Kingston, N. Y.; Philadelphia Dental College, 1891; died January 29; aged 84.

Hoskins, J. Milton, McComb, Miss.; School of Dentistry, Vanderbilt University, 1919; died December 16; aged 56.

Houghton, Earl W., Thompsonville, Conn.; School of Dentistry, Temple University, 1910; died January 5; aged 65.

Hubeny, Richard M., Chicago; Chicago College of Dental Surgery, Loyola University, 1909; died December 25; aged 69.

Jepsen, J. Christian, Boston; Dental School, Tufts College, 1901; died January 25; aged 79.

Johnson, John J., Knoxville, Tenn.; Dental Department, Meharry Medical College, 1904; died November 21.

Judson, Frank E., Fairfield, Conn.; Philadelphia Dental College, 1905; died January 9; aged 71.

Kelly, Joseph J., Scranton, Pa.; School of Dentistry, Temple University, 1927; died January 6.

Knower, Kenneth K., Casa Grande, Ariz.; Kansas City-Western Dental College, 1922; died February 28; aged 57.

Kussy, Joseph, Newark, N. J.; School of Dentistry, University of Pennsylvania, 1898; died February 16; aged 78.

Latham, Harry E., New York; Philadelphia Dental College, 1901; died February 5; aged 77.

Lenk, Abe S., Beaver Falls, Pa.; School of Dentistry, University of Pittsburgh, 1931; died December 5.

Lindelien, Clifford O., Minneapolis; College of Dentistry, University of Minnesota, 1917; died December 23; aged 58.

Linsley, James H., New Philadelphia, Ohio; College of Dental Surgery, University of Michigan, 1907; died March 15, 1951.

Linsley, Sam E., St. Paul; Chicago College of Dental Surgery, Loyola University, 1902; died December 29.

Looney, Edward C., Montclair, N. J.; School of Dentistry, University of Pennsylvania, 1917; died January 21; aged 56.

Lowenstein, Julius, New York; New York College of Dentistry, 1903; died December 29; aged 70.

Lubliner, Leo M., New York; New York College of Dentistry, 1908; died January 1, 1951; aged 68.

MacLennan, John A., Bridgeport, Conn.; Baltimore College of Dental Surgery, 1916; died February 5; aged 67.

Macpherson, Cecil A., Chicago; Chicago College of Dental Surgery, Loyola University, 1924; died February 16; aged 68.

Mahan, Harland C., Berwyn, Ill.; Chicago College of Dental Surgery, Loyola University, 1916; died November 26.

Marggraff, Fred C., Waterbury, Conn.; Pennsylvania College of Dental Surgery, Philadelphia, 1899; died February 14.

Marts, Raymond J., Middletown, Ohio; College of Dentistry, Ohio State University, 1924; died November 27; aged 54.

McConnell, Winton C., Lansing, Mich.; died January 20; aged 78.

McCorkle, Eri J., Peoria, Ill.; Chicago College of Dental Surgery, Loyola University, 1911; died November 6; aged 64.

McLean, John J., Homestead, Pa.; School of Dentistry, University of Pittsburgh, 1923; died December 13.

McMahon, Leo J., San Francisco; College of Physicians and Surgeons, San Francisco, 1902; died January 18; aged 72.

Meyrowitz, Mervin, New York; College of Dentistry, New York University, 1915; died October 24; aged 59.

Middaugh, W. Clay, Easton, Pa.; School of Dentistry; University of Pennsylvania, 1892; died February 8; aged 80.

Miller, Frank L., Anadarko, Okla.; Kansas-City-Western Dental College, 1923; died March 8, 1951.

Mills, M. May, Delaware, Ohio; died December 27.

Miner, Clayton L., St. Cloud, Minn.; College of Dentistry, University of Minnesota, 1918; died January 16; aged 55.

Moore, Leo E., Tampa, Fla.; Department of Dentistry, Starling-Ohio Medical College, 1910; died December 24; aged 63.

Moorehouse, Cecil L., Long Beach, Calif.; College of Dentistry, University of Southern California, 1926; died December 26; aged 50.

Mosley, Marion R., Biloxi, Miss.; College of Dentistry, University of Tennessee, 1911; died March 5, 1951.

Mulholland, Frederick G., Cleveland; School of Dentistry, Western Reserve University, 1915; died December 13; aged 68.

Neely, Bud W., Franklin, Ky.; Louisville College of Dentistry of Centre College, 1904; died October 23; aged 69.

Nelson, Alex C., Walla Walla, Wash.; Dental School, Northwestern University, 1912; died January 10; aged 65.

Neuwirth, Louis, New York; New York College of Dentistry, 1904; died August 13.

Nicholas, Charles E., Harrisonburg, Va.; Dental Department, University College of Medicine, Virginia, 1904; died December 22.

Nonnamaker, Fred C., Chicago; Dental School, Northwestern University, 1913; died March 7; aged 66.

Nordquist, Toddes G., Downey, Ill.; Chicago College of Dental Surgery, Loyola University, 1922; died January 4.

Osborne, Jay M., Stanford, Calif.; College of Dental Surgery, University of Michigan, 1903; died January 23; aged 78.

Parker, Charles S., Orange, Calif.; Chicago College of Dental Surgery, Loyola University, 1895; died February 2; aged 82.

Peart, Wilson J., Mansfield, Ohio; Department of Dentistry, Starling-Ohio Medical College, 1910; died December 12; aged 67.

Peck, Chauncey C., Seattle; College of Dentistry, University of Iowa, 1918; died December 15.

Peek, Levin S., Fontanelle, Iowa; College of Dentistry, University of Iowa, 1900; died December 26; aged 79.

Prior, Philip W., Stamford, Conn.; New York College of Dentistry, 1893; died January 20; aged 80.

Ravnsborg, Per P., Aneta, N. D.; Chicago College of Dental Surgery, Loyola University, 1905; died January 23; aged 75.

Reed, Ulric D., Los Angeles; College of Dentistry, University of Southern California, 1900; died February 12; aged 79.

Regener, C. Oliver, Hawthorne, N. J.; Philadelphia Dental College, 1898; died February 18; aged 75.

Rice, James K., Cherokee, Iowa; College of Dentistry, University of Iowa, 1898; died December 4; aged 81.

Rich, Ralph S., Odessa, Texas; College of Dentistry, University of Nebraska, 1924; died January 22; aged 56.

Rich, William G., Detroit; College of Dental Surgery, University of Michigan, 1916; died February 4; aged 58.

Robinson, Lora W., Winsted, Conn.; Philadelphia Dental College, 1883; died January 17; aged 94.

Roe, Walter, Chicago; Dental School, Northwestern University, 1915; died February 2; aged 58.

Roll, William A., Minneapolis; School of Dentistry, University of Minnesota, 1911; died January 10; aged 64.

Rosenberg, Samuel J., Pittsburgh; School of Dentistry, University of Pittsburgh, 1926; died November 30; aged 47.

Rosencrans, Harry L., Lebanon, Ohio; Cincinnati College of Dental Surgery, 1907; died December 31; aged 67.

Russell, Frank L., Decatur, Ill.; Dental School, Northwestern University, 1906; died January 15.

Schaeffer, Oscar M., Toledo, Ohio; Ohio College of Dental Surgery, University of Cincinnati, 1925; died November 5; aged 53.

Shaffer, Harry M., Buena Park, Calif.; College of Dentistry, University of Southern California, 1915; died February 5; aged 71.

Sheldon, Matthew O., Steeleville, Ill.; School of Dentistry, St. Louis University, 1924; died January 28; aged 52.

Shepard, Harry P., Rochester, N. Y.; Chicago College of Dental Surgery, Loyola University, 1913; died January 5; aged 63.

Sheppe, Andrew J., Ballard, W. Va.; Baltimore College of Dental Surgery, 1917; died June 7; aged 60.

Sheridan, Thomas, Jacksonville, Fla.; Chicago College of Dental Surgery, Loyola University, 1894; died December 20; aged 87.

Shreve, Carl, Willoughby, Ohio; School of Dentistry, Indiana University, 1917; died January 9.

Simpson, Hannibal N., Greensboro, N. C.; Atlanta Dental College, 1909; died January 17.

Smathers, Gideon S., Asheville, N. C.; Atlanta-Southern Dental College, 1908; died December 3; aged 63.

Smith, Sidney J., La Jolla, Calif.; Missouri Dental College, St. Louis, 1887; died January 9; aged 87.

Sobel, Samuel, New York; School of Dentistry, University of Pennsylvania, 1909; died September 8; aged 64.

Spinning, Glen S., Indianapolis; School of Dentistry, Indiana University, 1933; died February 7; aged 47.

Striffler, Harry C., Pontiac, Mich.; College of Dental Surgery, University of Michigan, 1915; died December 28; aged 60.

Taylor, Kirman E., Denver, Colo.; School of Dentistry, University of Colorado, 1919; died January 31; aged 56.

Thomas, Howard F., Fort Wayne, Ind.; Indiana Dental College, 1918; died Janury 4; aged 59.

Weisenberger, Elmer G., Toledo, Ohio; Ohio College of Dental Surgery, University of Cincinnati, 1900; died February 2; aged 74.

Willison, Franz E., Hastings, Mich.; Ohio College of Dental Surgery, University of Cincinnati, 1892; died January 20; aged 83.

Wolfenberger, Clifton W., Las Animas, Colo.; Chicago College of Dental Surgery, Loyola University, 1899; died January 20.

Directory

OFFICERS

LeRoy M. Ennis, President ..... 4001 Spruce St., Philadelphia
Otto W. Brandhorst, President-Elect ..... 4952 Maryland Ave., St. Louis
David J. Fitzgibbon, First Vice-President ..... 601 19th St., N.W., Washington, D.C.
Perley M. Cunningham, Second Vice-President ..... 510 Hynds Bldg., Cheyenne, Wyo.
Oscar P. Snyder, Third Vice-President ... Walter Reed Army Medical Center, Washington, D.C.
Ernest G. Sloman, Speaker, House of Delegates ..... 344 14th Street, San Francisco
Harold Hillenbrand, Secretary ..... 222 E. Superior St., Chicago
C. Willard Camalier, Assistant Secretary ..... 1726 Eye St., N.W., Washington, D.C.
Louis M. Cruttenden, Assistant Secretary ..... 222 E. Superior St., Chicago
H. B. Washburn, Treasurer ..... Lowry Medical Arts Bldg., St. Paul
Lon W. Morrey, Editor ..... 222 E. Superior St., Chicago

BOARD OF TRUSTEES

William R. Alstadt, 1954, Twelfth District ..... 610 Boyle Bldg., Little Rock, Ark.
Bernerd C. Kingsbury, 1954, Thirteenth District ..... 490 Post St., San Francisco
Percy T. Phillips, 1954, Second District ..... 18 E. 48th St., New York
Clarence S. Renouard, 1954, Eleventh District ..... 304 Phoenix Bldg., Butte, Mont.
W. Earle Craig, 1953, Third District ..... 8113 Jenkins Arcade, Pittsburgh
L. H. Jacob, 1953, Eighth District ..... Jefferson Bldg., Peoria, Ill.
James E. John, 1953, Fifth District ..... Medical Arts Bldg., Roanoke, Va.
Daniel F. Lynch, 1953, Fourth District ..... 1678 Primrose Road, N.W., Washington, D.C.
Obed H. Moen, 1953, Ninth District ..... Watertown, Wis.
J. B. Carr, 1952, Seventh District ..... Hume Mansur Bldg., Indianapolis
C. S. Foster, 1952, Tenth District ..... Dows Bldg., Cedar Rapids, Iowa
Charles I. Taggart, 1952, First District ..... 139 Bank St., Burlington, Vt.
Robert P. Thomas, 1952, Sixth District ..... Francis Bldg., Louisville, Ky.

BUREAUS

Economic Research and Statistics: B. D. Moen, Director, 222 E. Superior St., Chicago
Library and Indexing Service: Donald A. Washburn, Director, 222 E. Superior St., Chicago
Public Information: Herbert B. Bain, Director, 222 E. Superior St., Chicago

COUNCILS

Constitution and Bylaws: Max E. Ernst, Chm., Lowry Medical Arts Bldg., St. Paul
Dental Education: E. R. Westcott, Chm., The Mayfair, Albany and Atlantic Aves., Atlantic City, N.J.
Shailer Peterson, Secy., 222 E. Superior St., Chicago

Dental Health: David W. Brock, Chm., 6026 Enright Ave., St. Louis 12
Allen O. Gruebbel, Secy., 222 E. Superior St., Chicago

Dental Museum and Registry: Henry A. Swanson, Chm., 1726 Eye St., N.W., Washington, D.C.

Dental Research: M. K. Hine, Chm., 1121 W. Michigan St., Indianapolis

Dental Therapeutics: Thomas J. Hill, Chm., 2085 Adelbert Road, Cleveland
J. Roy Doty, Secy., 222 E. Superior St., Chicago

Dental Trade and Laboratory Relations: F. W. Herbine, Chm., 230 N. Fifth St., Reading, Pa.

Federal Dental Services: R. H. Friedrich, Chm., 960 Park Ave., Plainfield, N.J.

Hospital Dental Service: Frank B. Hower, Chm., 814 Heyburn Bldg., Louisville, Ky.

Insurance: Paul W. Zillmann, Chm., 29 Walden Ave., Buffalo

International Relations: D. J. Aubertine, Chm., 760 Market St., San Francisco

Journalism: Charles A. Wilkie, Chm., 1 Hanson Place, Brooklyn

Judicial Council: H. B. McCarthy, Chm., 5821 Bellona Ave., Baltimore

Legislation: E. Harold Gale, Chm., 142 Washington Ave., Albany, N.Y.
Francis J. Garvey, Secy., 222 E. Superior St., Chicago

Membership: H. C. Jarvis, Chm., Mercantile Library Bldg., Cincinnati

National Board of Dental Examiners: Robert J. Wells, Chm., 1525 E. 53rd St., Chicago
Shailer Peterson, Secy., 222 E. Superior St., Chicago

Relief: Leo W. Kremer, Chm., 55 E. Washington St., Chicago

Scientific Session: William A. Garrett, Chm., Candler Bldg., Atlanta, Ga.

SECTION CHAIRMEN

Operative Dentistry: Morton H. Mortonson, Jr., 735 N. Water St., Milwaukee

Oral Surgery and Anesthesia: H. Newman Brownson, 7046 Hollywood Blvd., Hollywood, Calif.

Orthodontics and Oral Development: William R. Joule, 549 High St., Newark, N.J.

Pedodontics: William A. Jordan, Minnesota Dept. of Health, University Campus, Minneapolis

Periodontics: Walter Leabo, 706 Medical Arts Bldg., Shreveport, La.

Practice Management: Charles H. Kendall, 2866 N. Oakland Ave., Milwaukee

Prosthodontics, Full Dentures: Theodore A. Bodine, 904 Akron Savings and Loan Bldg., Akron, Ohio

Prosthodontics, Partial Dentures: Alfred C. Young, 121 University Place, Pittsburgh

Public Health Dentistry: Bruce D. Forsyth, USPHS, Fourth and D Sts., S.W., Washington, D.C.

Research: John W. Knutson, USPHS, Federal Security Building South, Washington, D.C.

Roentgenology: William J. Updegrave, 230 W. Duncannon Ave., Philadelphia

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION
222 East Superior Street, Chicago 11, Illinois
WHitehall 4-6730

LON W. MORREY, *Editor* JOHN J. HOLLISTER, *Business Manager*

All expressions of opinions and all statements of supposed facts are published on the authority of the writer over whose signature they appear, and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association. *Articles* are accepted with the understanding that they have not been published previously and that they are submitted solely to THE JOURNAL. *Advertising copy* must conform to the official standards established by the American Dental Association. *Notice of change of address* should be received one month before the change is to be effective. *Orders for reprints of* JOURNAL articles must be received by the Business Manager's office not later than the 15th of the month of issue in order to secure advantage of the lowest possible prices. Orders received after this date are subject to special quotation.

Announcements

MEETINGS OF THE AMERICAN DENTAL ASSOCIATION

Ninety-Third Annual Session	Sept. 8-11, 1952	St. Louis
Ninety-Fourth Annual Session	Sept. 28-Oct. 1, 1953	Cleveland
Ninety-Fifth Annual Session	Nov. 8-11, 1954	Miami

MEETINGS OF STATE SOCIETIES

State	Date	Place	Secretary	Address
Alabama			G. W. Matthews	1922 Tenth Ave., S., Birmingham 5
Alaska	July 14-17	Anchorage	R. A. Smithson	Box 1293, Anchorage
Arizona			E. M. Scott	17 E. Welden Ave., Phoenix
Arkansas			D. M. Hamm	White Bldg., Clarksville
California			L. R. Ludwigsen	450 Sutter St., San Francisco
S. California	May 5-7	Los Angeles	C. A. Moss	1401 S. Hope St., Los Angeles
Colorado	Oct. 5-8	Colorado Springs	R. A. Downs	1422 Grant St., Denver
Connecticut	May 21-23	Bridgeport	E. S. Arnold	37 Linnard Rd., W. Hartford
Delaware	Jan. 14, 1953	Wilmington	J. J. Ficca	2130 Lancaster Ave., Wilmington
District of Columbia			K. H. Wood	202-1835 Eye St., N. W. Washington
Florida			T. A. Price	808 Congress Bldg., Miami
Georgia	Oct. 12-15	Savannah	J. M. Heard, Jr.	803 Persons Bldg., Macon
Hawaii	June 11-14	Honolulu	J. H. Dawe	810 N. Vineyard St., Honolulu 17
Idaho	June 30-July 2	Sun Valley	F. E. Carpenter	123 Main Ave., W., Twin Falls
Illinois	May 19-22	Springfield	P. W. Clopper	623 Jefferson Bldg., Peoria 2
Indiana	May 12-14	Indianapolis	E. E. Ewbank	Kingman
Iowa	May 5-7	Des Moines	H. I. Wilson	639 Insurance Exchange Bldg., Des Moines
Kansas	May 11-14	Topeka	F. A. Richmond	861 Brotherhood Bldg., Kansas City
Kentucky	Apr. 7-9, 1953	Louisville	A. B. Coxwell	1976 Douglas Blvd., Louisville
Louisiana			J. S. Bernhard	2515 Line Ave., Shreveport
Maine	June	Rockland	S. Gower	Skowhegan
Maryland	May 4-7	Baltimore	E. L. Pessagno, Jr.	415 Medical Arts Bldg., Baltimore 1
Massachusetts	May 4-7	Boston	H. E. Tingley	12 Bay State Road, Boston
Michigan			F. Wertheimer	Michigan Dept. of Health, Lansing
Minnesota	Feb. 23-25, 1953	Minneapolis	C. V. E. Cassel	242 Lowry Medical Arts Bldg., St. Paul
Mississippi	June 9-12	Biloxi	H. M. Campbell	102 Professional Bldg., Tupelo
Missouri			R. R. Rhoades	201 Merchants Bank Bldg., Jefferson City
Montana	May 8-10	Butte	C. S. Renouard	404 Phoenix Bldg., Butte
Nebraska	May 12-14	Omaha	F. A. Pierson	1112 Federal Securities Bldg., Lincoln
Nevada	June	Reno	R. La Fond	Medical Dental Bldg., Reno
New Hampshire	June 29-July 1	Bretton Woods	F. E. Williams	814 Elm St., Manchester
New Jersey			J. G. Carr	407 Cooper St., Camden
New Mexico			J. S. Eilar	Suite 7, Medical Arts Square, Albuquerque
New York	May 12-15	Syracuse	C. A. Wilkie	1 Hanson Place, Brooklyn
North Carolina	May 11-14	Pinehurst	B. N. Walker	Liberty Life Bldg., Charlotte
North Dakota	May 15-17	Minot	J. H. Lunday	302 Black Bldg., Fargo
Ohio			E. G. Jones	185 E. State St., Columbus
Oklahoma			R. C. Calkin	109½ W. Oklahoma, Guthrie
Oregon		Portland	H. C. Fixott, Jr.	308 Selling Bldg., Portland
Panama Canal Zone	Dec. 9		F. D. Buckley	Box 293, Rodman
Pennsylvania	May 5-7	Reading	M. D. Zimmerman	217 State St., Harrisburg
Puerto Rico	Jan. 1953		A. Guiñones	San German
Rhode Island			E. L. Bessette	1745 Broad St., Cranston 5
South Carolina		Greenville	J. R. Owings	7 Medical Court, Greenville
South Dakota	May 18-20	Mitchell	E. W. Elmen	Sioux Falls

Tennessee	May 5-7	Memphis	W. L. McCulley	Brown Bldg., Cleveland
Texas	Apr. 28-May 1	Fort Worth	W. Ogle	3607 Gaston Ave., Medical Bldg., Dallas
Utah	June 11-14	Zion National Park	E. O. Thompson	915 Medical Arts Bldg., Salt Lake City
Vermont	May	Woodstock	W. J. Reardon	Rutland
Virginia			J. E. John	804 Medical Arts Bldg., Roanoke
Washington	May 15-17	Seattle	C. R. Flood	230 Medical-Dental Bldg., Seattle
West Virginia	July 14-16	White Sulphur Springs	A. B. Drake	508 West Virginia Bldg., Huntingdon 1
Wisconsin			R. A. Mason	964 N. 27th St., Milwaukee
Wyoming		Casper	T. J. Drew	State Capitol Bldg., Cheyenne

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

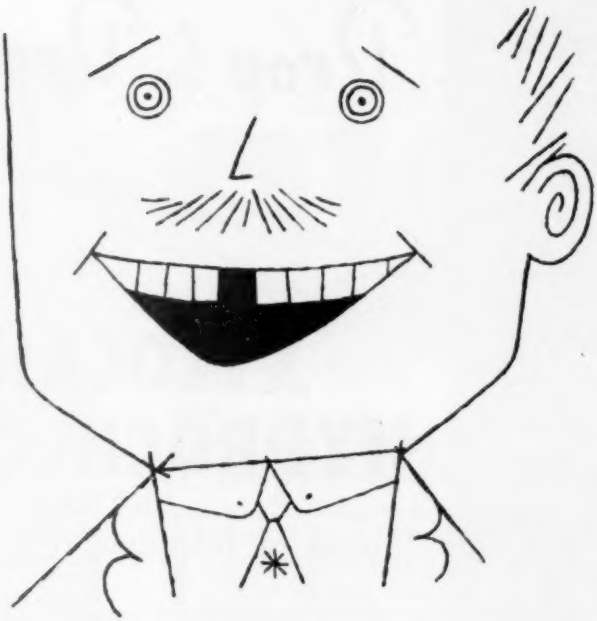
State	Date	Place	Secretary	Address
Alabama	June 16	Birmingham	M. D. Edwards	132 Adams Ave., Montgomery
Alaska	July 7-11	Anchorage	J. H. Geyer	P. O. Box 915, Juneau
Arizona	Aug. 11-16	Florence	R. K. Trueblood	25 N. Second Ave., Glendale
Arkansas	June 23-26		H. O. Weatherly	205 Halter Bldg., Conway
California			K. I. Nesbitt	507 Polk St., San Francisco 2
Colorado	June 23-27	Denver	C. K. Phillips	724 Republic Bldg., Denver 2
Connecticut	June 16-21*	Bridgeport	C. G. Brooks	302 State St., New London
Delaware	June 16-18*	Wilmington	P. K. Musselman	143 W. Main St., Newark
District of Columbia			W. M. Falls	1801 Eye St., N. W. Washington 6
Florida	July 7-12*	Jacksonville	A. W. Kellner	P. O. Box 155, Hollywood
Georgia			S. H. Yarbrough	Medical Arts Bldg., Columbus
Hawaii	Aug. 27-Sept. 1*	Honolulu	H. L. Houvener	427 Dillingham Bldg., Honolulu
Idaho	June 23	Boise	W. K. Adams	718 Arthur St., Caldwell
Illinois			W. A. McKee	503 Wood Bldg., Benton
Indiana	June 17-20*	Indianapolis	C. A. Frech	504 Broadway, Gary
Iowa	May 19-23	Iowa City	H. M. Willits	719 Roshek Bldg., Dubuque
Kansas	June 2-5	Kansas City, Mo.	G. L. Teall	Box 71, Hiawatha
Kentucky	June 2-5	Louisville	R. I. Todd	Western Union Bldg., Richmond
Louisiana			A. R. de Nux	Marksville
Maine	June 16-19	Boston	R. A. Derbyshire	Box 387, Skowhegan
Maryland	June 9-11	Baltimore	H. Levin	3429 Park Heights Ave., Baltimore 15
Massachusetts	June 23, 24, 26, 27‡ June 25-27‡‡	Boston	J. C. Wilson	State House, Boston 33
Michigan	June 8-14	Ann Arbor	J. L. Champagne	3714 W. McNichols Road, Detroit 21
Minnesota			F. A. Larson	1632 Washington St., N. E. Minneapolis
Mississippi	June 17-19*	Jackson	J. C. Boswell	508 Lamar Life Bldg., Jackson
Missouri	June 9, 10, 13, 14 June 11-14	St. Louis Kansas City	R. R. Rhoades	Central Trust Bldg., Jefferson City
Montana			V. J. Quinn	Box 865, Helena
Nebraska	June 3-7	Lincoln	H. E. Weber	1210 Federal Securities Bldg., Lincoln
Nevada			G. C. Steinmiller	Masonic Temple, Reno
New Hampshire	June 20, 21		D. J. Freese	4 Wall St., Concord
New Jersey	June 2, 3**‡‡ June 4-6§ June 12, 13**	Philadelphia Trenton New York	W. A. Wilson	150 E. State St., Trenton 8
New Mexico	June 23-26	Santa Fe	J. J. Clarke, Sr.	Artesia
New York			D. W. Beier	23 S. Pearl St., Albany 7
North Carolina	June 23-26	Raleigh	F. O. Alford	1109 Liberty Life Bldg., Charlotte 2
North Dakota	July 7-11	Fargo	A. B. Crabtree	Ellendale
Ohio	June 23-27	Columbus	H. B. Smith	322 E. State St., Columbus
Oklahoma			J. B. Cole, Jr.	706 Asp, Norman
Oregon	June 9-12*		F. L. Utter	506 Pioneer Trust Bldg., Salem
Pennsylvania	June 19-21* June 21†† June 23-25†	Philadelphia Philadelphia and Pittsburgh	R. E. V. Miller	Northampton National Bank Bldg., Easton
Puerto Rico		Santurce	L. C. Coll	Box 3717, Santurce
Rhode Island			F. M. Hackett	267 Academy Ave., Providence
South Carolina	June 26-28		T. C. Sparks	1315 Pickens St., Columbia
South Dakota	June 22-25		K. A. Stormo	Lead
Tennessee	June 9-13	Memphis	F. S. Maxey	804 Benn e Dillon Bldg., Nashville 3
Texas	June 15-21‡	Dallas	R. T. Weber	312 Capital National Bank Bldg., Austin
Utah	June 23-27	Salt Lake City	F. E. Lees	324 State Capitol Bldg., Salt Lake City
Vermont	June 23-25	Montpelier	F. A. Reid	Windsor
Virginia			J. M. Hughes	715 Medical Arts Bldg., Richmond 19

Washington	June 16-20		J. B. Kiefer, Jr.	510 Cobb Bldg., Seattle
West Virginia	June 23-25	West Liberty	C. A. Laughlin	613 Prunty Bldg., Clarksburg
Wisconsin	June 16-20*	Milwaukee	S. F. Donovan	Tomah
Wyoming	June 23-25	Casper	W. A. Hocker	212 O & S Bldg., Casper

*Dentistry and dental hygiene.
**Dental clinical examinations.
†Dental and dental hygiene written examinations.
§Dental written examinations.
††Dental hygiene clinical examinations.
‡Dental examinations.
‡‡Hygienists' examinations.

MEETINGS OF OTHER ORGANIZATIONS

Name	Date	Place	Secy. or Chm.	Address
American Academy of Dental Medicine	May 29-31	Montreal, Canada	W. M. Greenhut Secy.	124 E. 84th St., New York 28
American Association of Dental Examiners	Sept. 5-6	St. Louis	C. A. Bumstead Secy.	924 Stuart Bldg., Lincoln, Neb.
American Association of Orthodontists, Central Section	Oct. 13, 14	Omaha	F. B. Lehman Secy.	1126 Merchants National Bank Bldg., Cedar Rapids, Iowa
American Board of Dental Public Health	Sept. 12, 13	St. Louis	P. E. Blackerby, Jr. Secy.	250 Champion St., Battle Creek, Mich.
American Board of Oral Pathology	Sept. 7	St. Louis	J. L. Bernier Secy.	Army Institute of Pathology, Washington, D.C.
American Board of Pedodontics	Aug. 4-7	San Francisco	R. L. Ireland Secy.	College of Dentistry, University of Nebraska, Lincoln, Neb.
American College of Dentists	Sept. 7	St. Louis	O. W. Brandhorst Secy.	4952 Maryland Ave., St. Louis 8
American Dental Assistants Association	Sept. 8-11	St. Louis	M. L. Martin Exec. Secy.	410 First National Bank Bldg., La Porte, Ind.
American Dental Society of Europe	July 15-18	London, England	F. D. Derrick Secy.	140 Park Lane, London W. 1, England
American Denture Society	Sept. 5, 6	St. Louis	A. L. Roberts Secy.	Aurora National Bank Bldg., Aurora, Ill.
American Public Health Association	Oct. 20-24	Cleveland	R. M. Atwater Exec. Secy.	1790 Broadway, New York 19
American Society of Oral Surgeons	Oct. 8-11	New Orleans	R. F. Whalen Exec. Secy.	1112 E. Clay St., Richmond, Va.
Canadian Dental Association and British Columbia Dental Association, Golden Jubilee	June 15-18	Vancouver, B. C., Canada	C. M. Whitworth Secy.	Joint Convention Committee, Canadian Dental Association, 218 Medical-Dental Bldg., Vancouver, B. C., Canada
Eleventh International Dental Congress	July 19-26	London, England	G. H. Leatherman Hon. Secy.	35 Devonshire Place, London W. 1, England
Great Lakes Society of Oral Surgeons	Sept. 21	Cleveland	B. B. Cook Secy.	10314 Puritan Ave., Detroit 21
National Board of Dental Examiners	Dec. 1, 2		S. Peterson Secy.	222 E. Superior St., Chicago 11
New Orleans Dental Conference	Nov. 9-12	New Orleans	M. R. Matta Secy.	629 Maison Blanche Bldg., New Orleans
Northeastern Society of Orthodontists	Nov. 10, 11	Montreal, Canada	O. Jacobson Secy.	35 W. 81st St., New York
Odontological Society of Western Pennsylvania	Nov. 11-13	Pittsburgh	W. E. Craig Secy.	206 Jenkins Bldg., Pittsburgh 22
Southern Society of Orthodontists	Aug. 10-13	Asheville, N.C.	F. P. Bowyer Secy.	608 Medical Arts Bldg., Knoxville, Tenn.



didn't feel a thing!

. . . Nor, in most cases, will he feel a thing afterward if you anesthetize with Abbott Procaine Dental Cartridges.

These ready-to-use cartridges assure your patient effective local anesthesia with only minimal postoperative pain, and no untoward or painful tissue irritation. While you, Doctor, are assured of solutions that are sterile, isotonic and adjusted to a pH that provides maximum stability.

Each cartridge is plainly labeled, and will fit all standard syringes. Your usual source of supply has Abbott Procaine Cartridges in all four commonly-used concentrations. Abbott

abbott's

PROCAINE HYDROCHLORIDE

2% with Epinephrine 1:60,000, 1:50,000, 1:30,000
4% with Epinephrine 1:50,000

RAPID

POTENT

STABLE

RAPID

POTENT

SAFE

STABLE

RAPID

Drop for Drop

XYLOCAINE® HYDROCHLORIDE

ASTRA

(Brand of lidocaine hydrochloride*)

invites clinical comparison with any other local anesthetic commonly employed in modern dentistry for local anesthesia that is extremely rapid in onset, deeply profound, widely diffused and of adequate duration (1). Minimal volumes are sufficient for routine procedures.

SUPPLIED

stocked by leading dental supply dealers as a 2% solution, without epinephrine and with epinephrine 1:100,000 or 1:50,000; dispensed in 1.8 cc cartridges, packed 50 cartridges to a vacuum-sealed tin. Also available in 20 cc multiple dose vials packed 5 vials to a carton.

(1) Supporting bibliography of references to nearly 100 original papers sent to physicians and dentists on request addressed to:

ASTRA PHARMACEUTICAL PRODUCTS, INC.
WORCESTER, MASS. U.S.A.

*U.S. Patent No. 2,441,498

NOW

Pulpdent ROWER
PAT. PENDING

the ORIGINAL
PRE-MIXED
calcium hydroxide-
methyl cellulose
paste*

for
PULP CAPPING
PULPOTOMY
CAVITY LINING

Stimulates odontoblastic regeneration and forms a new dentin barrier.

- **always ready**

  PULPDENT (Rower) is supplied in collapsible tubes, from which it may be expressed at will.

- **suitable consistency**

  PULPDENT (Rower) is ready for use as expressed from the tube, requiring no further mixing or processing.

- **economical to use**

  One tube of PULPDENT (Rower) delivers more than 5 grams of paste, costs only $1.50. Order from your local dental supply house.

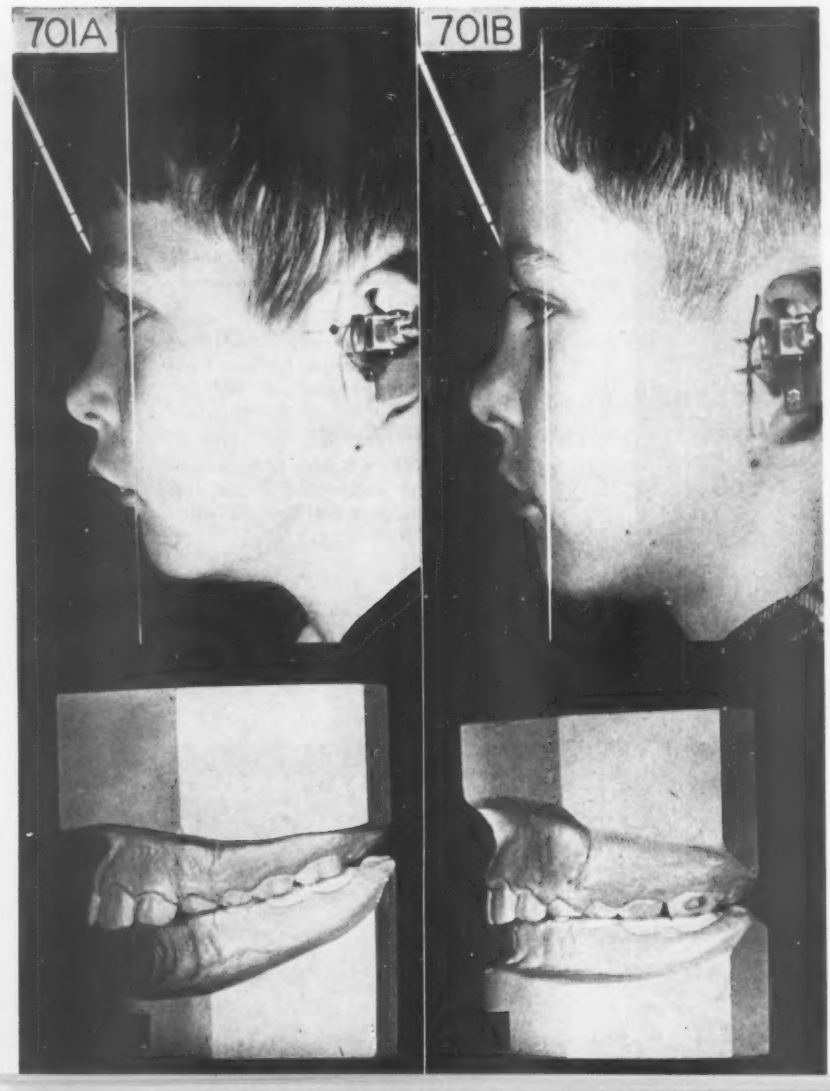
**Bibliography forwarded on request.*

ROWER DENTAL MFG. CORP.
BOSTON 16, MASS. U. S. A.

Saunders books

. . . *A new book on* ORTH

A great amount of interest has been aroused — among orthodontists and non-orthodontists alike — by the unusually successful results which Dr. BERCU FISCHER has obtained in his orthodontic cases. This new book is a detailed, copiously illustrated description of his methods.



The 1180 illustrations include photographs of patients and casts, (before and after treatment); "before and after" x-rays; and how-to-do-it drawings of actual technic

ODONTICS

Diagnosis • Prognosis • Treatment

by BERCU FISCHER, D.D.S.

DR. FISCHER'S successful method of managing orthodontic problems is based on the following principles:

1. ***Sectional Treatment***
   Selective orthodontic movement is brought about in those teeth which are preventing the patient's *natural forces* from moving the teeth into positions normal for that individual. Natural movement of teeth follows the correction by the operator of this "interference." With this method, orthodontic force is applied only to a minimum number of teeth.

2. ***Early Treatment***
   Under DR. FISCHER'S plan, treatment can be begun in the mixed dentition, with these advantages: the operator can effect the most desirable changes in the dentofacial complex, because tissue tolerance and adaptation are at their maximum; and the incidence of the most important hazards (root resorption and instability of the end result) is greatly lessened.

3. ***Extraoral Force***
   The use of occipital force solves the problem of control of anchorage.

4. ***The Individuality Hypothesis***
   The keynote of the book is the author's explanation of how to determine the *normal dentofacial relationship for any one individual.*

By BERCU FISCHER, D.D.S., New York City, 340 pages, 6½" x 9¾", with 1180 illustrations on 212 figures. About $12.00. *New.*

Using SAUNDERS EASY PAYMENT PLAN, you can pay for your book purchases in twelve monthly installments (minimum monthly payment, $3.00). No carrying charges whatsoever.

Archer's Manual of Dental Anesthesia

Archer's Manual of Oral Surgery

McCall & Wald's Dental Roentgenology

Thoma's Oral Diagnosis

Ask About These Books!

Examine it for 30 days at no cost!

Order Form

5-52

W. B. SAUNDERS COMPANY

West Washington Square — Philadelphia 5

Send me on 30-day approval: ☐ Easy Payment Plan

☐ Fischer's Orthodontics - - - - - - - - About $12.00

Name.....

Address.....

CLASSIFIED ADVERTISING

Forms close on 25th of second month preceding month of issue

Remittance Must Accompany Classified Ads.

Advertisements cost $3.50 not exceeding 30 words, additional words 10c each. Commercial agency advertisements, $3.50 for 20 words, additional words 13c each. Publisher reserves the right to determine classification. An extra fee of 25c is charged advertisers who have answers sent care of A.D.A. and in such cases we do not furnish name or address to inquirers. This rate applies for each insertion.

PRACTICES AND OFFICES FOR SALE

COLORADO—Established dental office in Colorado town of 15,000. Pleasant town in which to live, fine people, wonderful year round climate, good fishing and hunting. What's more you can make money immediately. Address ADA Box No. 49.

●

CONNECTICUT—One or two chair bungalow dental office with or without latest Ritter equipment. Reception room shared with chiropodist. Residential suburb of Hartford, Connecticut, town of 45,000. Population is one of the wealthiest per capita, ideal flexible opportunity. Address ADA Box No. 50.

●

ILLINOIS—Dental office in central Illinois city of 40,000. Excellent location, for sale with or without equipment. Address ADA Box No. 17.

●

MICHIGAN—Successful, select, 28 year dental practice in county seat town of 12,000. Beautiful colonial lake shore home with ground floor office, two ultra-equipped operating rooms, reception room, large laboratory. Good hunting, fishing, sailing. Present owner retiring but will stay to transfer practice to new owner. Reasonable terms. Address ADA Box No. 18.

●

MICHIGAN—Dental practice, established over twenty-five years. Modern Ritter equipment. Gross about $20,000.00 yearly. Excellent hunting and fishing. Present owner retiring. Address ADA Box No. 33.

●

MONTANA—Splendid opportunity for young man to succeed in active practice, for rent, due to death, in Missoula, Montana. Six room modern, two chair stucco bungalow office building in residential district for rent or lease to man buying equipment and practice. Direct replies to attorneys for administrator: Smith, Boone and Rimel, First National Bank Building, Missoula, Montana.

●

NEW JERSEY—Fully equipped two-chair brick bungalow office in Southern New Jersey, close to Atlantic City. New construction, ample grounds landscaped, busy practice. Bargain for quick settlement. Address ADA Box No. 51.

●

NEW MEXICO—Modern, two-chair Ritter equipped office. Two operating rooms, laboratory, reception room on ground floor, low rent. Town of 5,000. Excellent climate, fishing and hunting. Will sell location, lease and equipment, all or in part. Owner has other interests. Address ADA Box No. 19.

NEW YORK—Fully equipped Ritter dental office and large active practice in East Central New York State. Three operating rooms with extra chair for impressions and treatments; X-ray, nitreous oxide machine and aspirator. Only dentist in village surrounded by beautiful, highly productive area. Excellent opportunity for a sincere, ambitious man. Reason for selling; moving out of the state. Five room apartment included. Direct replies to: Dr. J. W. Arthur, Middleburgh, New York.

●

NEW YORK—Northern New York State—residence, office, equipment, general practice of one deceased, for sale in small industrial town. Excellent opportunity for much needed dentist. $15,000 down. Address ADA Box No. 52.

■

NEW YORK—Suite in professional building for sale. 80 Hanson Place, Brooklyn 17, New York. Established dental practice. Direct replies to Dr. George C. Douglas, 80 Hanson Place, Brooklyn 17, New York.

●

OHIO—Established dental practice. Two operating chairs, ground floor bungalow type office. Beautiful living quarters attached. Second floor in complete four room unit may be rented. Located on corner of main thoroughfare of suburban Cincinnati. Practice grosses well above $20,000.00. Will sell building, office and practice on very easy terms. $5,000.00 down, balance as rent. Address ADA Box No. 34.

■

OHIO—Busy Ohio town; modern equipped; Majestic Weber X-ray unit; etc. Large clientele; drawing population of 5,000; with property; terms to responsible buyer. Direct replies to Apple Company, Brokers, Cleveland, Ohio.

●

OHIO—Orthodontic practice for sale. An excellent opportunity, must sell because of ill health. Available soon. Address ADA Box No. 53.

■

PENNSYLVANIA—First floor fully equipped two chair dental office in excellent condition. Modern furniture and equipment, including laboratory, waiting room, business office, dark room and rest room. Low rent. Located in northeastern Pennsylvania, county seat, population 8,000. Available immediately. Address ADA Box No. 54.

●

VIRGINIA—Completely modern equipped dental office in beautiful Shenandoah Valley. Two operating rooms, reception room, business office, private office, laboratory, dark room, closets. Very lucrative practice. Owner leaving to take Oral Surgery specialty. Reasonable terms. Direct replies to Dr. William T. Bushenana, 526 West Main Street, Waynesboro, Virginia.

VIRGINIA—Well established and lucrative general practice for sale in Arlington, Virginia. One room completely equipped, modern equipment. Room adjacent for 2nd chair, 4 room suite and laboratory. Magnificent opportunity for young dentist. Address ADA Box No. 55.

●

WASHINGTON—Long established practice, well furnished and equipped, in centrally located professional building. $1800.00 yearly. Also 9-room home, automatic oil heat, household electric appliances, partly furnished private beach on Puget Sound, $14,500. Address ADA Box No. 35.

LOCATIONS AVAILABLE

CALIFORNIA—Office for rent. Established practice, dentist drafted. North San Diego, Pacific beach. Rent only $100, modern spacious, ground floor professional building. Direct replies to Dr. George Ury, 628 National Avenue, National City, California.

●

WEST VIRGINIA—For lease, fully equipped dental office, new building, beautiful small city in Southern West Virginia, shortage of dentists, owner disabled. Direct replies to Dr. W. C. Epling, Box 507, Princeton, West Virginia.

OPPORTUNITIES AVAILABLE

CALIFORNIA—Openings in Dental Group for general practitioners, specialists, hygienists, with California license. Percentage basis or salary. Direct replies to Dr. Howard Jan, 3451 Piedmont Ave., Oakland, California.

●

MICHIGAN—Philanthropic foundation wants dentists under 40 years of age for public health work. Starting salary rate, $4,500 per annum. Michigan licensure not required provided the individual is a graduate of an accredited dental school and is licensed in another state. For detailed information write Kenneth R. Gibson, D.D.S., M.S.P.H., Director of Child Health Division, Children's Fund of Michigan, 660 Frederick St., Detroit 2, Michigan.

●

MICHIGAN—Dentist to perform and be in charge of the work involving the dental treatment of school children and other patients in a City Dental Clinic being established. Salary range $6010.00-$7090.00. Apply personnel office, City Hall, Dearborn, Michigan.

●

NEW JERSEY—Associate wanted by long established Orthodontist, chance to purchase interest or entire practice about three to six years. Excellent opportunity for right man. Give full details, age, training, experience, etc. Address ADA Box No. 56.

●

NEW YORK—Dentist wanted—Finely equipped office; New York license; minor oral surgery and anaesthesia experience advantageous, but practice general. Must be draft exempt. Give educational background and include recent photo if possible in your reply. Address ADA Box No. 57.

●

NORTH CAROLINA—Associate wanted for well established Orthodontist practice with privilege of buying later on. Address ADA Box No. 58.

NORTH CAROLINA—Dental intern appointments beginning July 1, 1952, are available at Charlotte Memorial Hospital. Applicants must be fourth year students in an approved dental school. This internship would include training and supervision in Oral Surgery, Periodontia, Prosthetics, Crown and Bridge, Indodontia, Pedodontia and Operative Dentistry. The dental service has the approval of the Council on Hospital Dental Service of the American Dental Association. Full maintenance and a $50.00 per month stipend are furnished. Please address request for application to Hospital Administrator, Charlotte Memorial Hospital, 1400 Scott Avenue, Charlotte, North Carolina.

●

OHIO—Capable general dentist under 40 to take over my practice on a 75-25% basis. Practice should gross over $10,000.00 yearly with unlimited possibilities for greater future earnings. Address ADA Box No. 59.

●

OHIO—Associate wanted for well established General Practitioner, salary and commission. Excellent opportunity for right man and a partnership later. Address ADA Box No. 41.

●

WASHINGTON—We have adequate space for specialist in children's dentistry or orthodontist. Terrific demand for either. Will rent or lease space. Modern bungalow type office, fully equipped. Direct replies to Drs. R. C. & B. M. Pepin, D.M.D., 1416 16th Avenue, Longview, Washington.

OPPORTUNITIES WANTED

DENTIST—Young dentist desires position in public health or with industrial firm. Graduate University of Illinois. Experienced in public health, private practice and teaching. Will go anywhere. Direct replies to Shay Medical Agency, 55 East Washington Street, Chicago 2, Illinois.

●

WANTED—In Connecticut or New York, dental office, practice, location, partnership, service exempt, valuable experience rehabilitation, surgery, prosthetics. Address ADA Box No. 60.

●

DENTIST—Ten years' experience in general practice, would like to associate with or purchase dental office in St. Louis or Missouri suburb from dentist contemplating retirement in near future. Address ADA Box No. 26.

●

DENTIST—Desires association in general practice with ethical dentist, in California, or will consider taking over established practice in that state. Qualified in air-abrasive technique. Address ADA Box No. 45.

●

DENTIST—Ending naval service in June. One year hospital internship and three years general practice. Interested in location, partnership or association in Oregon. Has Oregon Board. Direct replies to Dr. W. F. Dean, 2416 Deerpark St., San Diego 10, California.

●

DENTIST—Woman dentist—26 years' experience as head of dental department of a health center serving mostly children, desires a position in the field of public health, or director of a dental clinic for children. Pennsylvania license. Address ADA Box No. 66.

●

DENTIST—Successful practitioner 33 years old would like to relocate, for personal reasons. In town of less than 10,000 population in Nebraska, Minnesota or Wisconsin area. Address ADA Box No. 61.

DENTIST—Veteran, 8 years' experience seeks to purchase or associate in active general practice in Middle Atlantic states. Age 29. Address ADA Box No. 62.

•

DENTIST — With excellent orthodontic background desires association, partnership or position leading to purchase, with orthodontist or general practitioner in New York or New Jersey. Address ADA Box No. 63.

EQUIPMENT FOR SALE

X-RAY, Ritter ENY and Dental Unit, mobile stand, cassett, head, sinus and mastoid, boards, developing tank. Address ADA Box No. 64.

•

ORTHODONTIA LIBRARY, complete, bound set American Journal of Orthodontics, other rare books and German publications. Direct replies to Dr. E. H. Golden, 6204 Delmar Street, St. Louis 5, Missouri.

MISCELLANEOUS

WANTED TO BUY—Old or used dental books or journals. Leo L. Bruder, 1 De Kalb Avenue, Dept. 21, Brooklyn, New York. Dealer in out-of-print dentistry.

•

WANTED TO BUY—New or used wall type x-ray machine. Preferable Weber made. Must be late model and in excellent condition. Address ADA Box No. 65.

•

EQUIPMENT WANTED—Used child size dental chair in good operating condition. State model number or type and sale price. Address Paul Schiff, D.D.S., 808 E. Manchester, Inglewood, California.

•

MANUFACTURERS REPRESENTATIVE—To handle deluxe Dental Mix. State territory covered and present line. See our ad page A-10. Master Appliance Mfg. Co. Racine, Wisconsin.

Burneice Larson, Director
The Medical Bureau
Palmolive Building
Chicago, Illinois

OPPORTUNITIES WANTED

WANTED — Opportunities for great group of well qualified Dentists. Among our candidates are those who have specialized in the various fields of Dentistry and, also, men and women qualified for Teaching, Public Health Work and General Practice. Please outline your requirements and credentials of qualified candidates will follow. All negotiations strictly confidential.

OPPORTUNITIES AVAILABLE

WANTED — Dentists qualified in the various Dental specialties and for Teaching, Public Health Work and General Practice. Opportunities in all parts of America including countries outside continental United States. All negotiations strictly confidential. Please send for our ANALYSIS FORM so that we may prepare an Individual Survey of opportunities in your particular field.

SOLID BRONZE NAME SIGNS

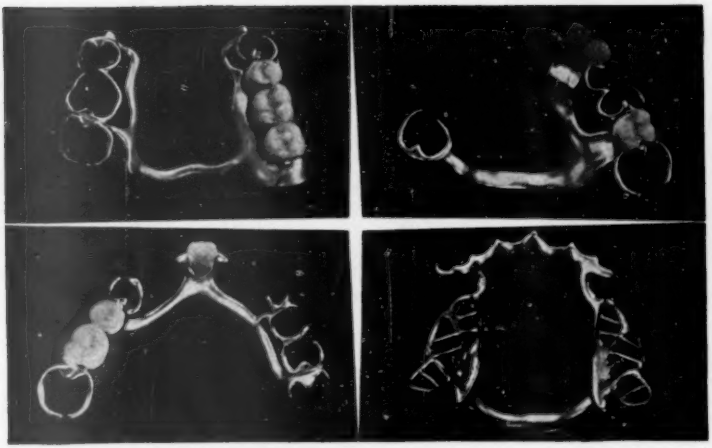
Cast, raised letters, drilled, with screws

3" x 12" — $10.80	3" x 14" — $12.60	3" x 16" — $14.40
4" x 14" — $16.80	4" x 16" — $19.20	4" x 18" — $21.60
5" x 16" — $24.00	5" x 18" — $27.00	5" x 20" — $30.00
6" x 18" — $32.40	6" x 20" — $36.00	6" x 25" — $45.00

Other sizes 30c per square inch. Signs with wording on both sides 45c per square inch.

COLLECT PLEASE SEND CHECK WITH ORDER

LAUER METAL SHOP • 1516 E. Baltimore Street • Baltimore 31, Md.



Your Patient's LASTING COMFORT...

Your Own EXACTING WORK

Both Suggest PLATINUM-PALLADIUM-GOLDS

Your patients benefit from your service long after the actual work is completed.

And when you fit partials cast from platinum-palladium-golds, you earn the respect and appreciation of your patients.

The gratifying comfort from appliances that retain their shape, that entail a minimum of weight and bulk and yet hold securely, is sound reason for recommending platinum-palladium-golds.

You, too, will find satisfaction in platinum-palladium-golds—an excellent medium for the best expression of dental skill and craftsmanship.

• • •

"PLATINUM-PALLADIUM-GOLDS IN DENTISTRY" contains many pages of helpful information. Have you sent for your free copy of this booklet?

Platinum Metals Division

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N.Y.

Actual Size
3⅝" x 5⅜"

Quality ANNOUNCEMENTS
AT GREATER SAVINGS!

TO CHANGE YOUR ADDRESS
TO OPEN A NEW PRACTICE
TO ESTABLISH AN ASSOCIATION

You must send Announcements to inform patients of any change that affects your practice. HISTACOUNT offers you distinctive Announcements that save you money and build prestige. HISTACOUNT volume buying facilities and production "know-how" keep quality high and costs low. Your satisfaction is unconditionally guaranteed. Use the coupon below to send for actual samples. Do it now—you'll save time and money!

PROFESSIONAL PRINTING COMPANY, INC.
202-208 TILLARY STREET. BROOKLYN 1, N. Y.

Gentlemen: Please send actual samples of Announcements and samples or literature of the items checked.

Dr._____

Address_____

City & State_____

6-5-2

HISTACOUNT® PRODUCTS

☐ LETTERHEADS ENVELOPES	☐ RECEIPT CARDS
☐ PROFESSIONAL CARDS	☐ GUMMED LABELS
☐ BILLHEADS STATEMENTS	☐ DRUG (PILL) ENVELOPES
☐ PRESCRIPTION BLANKS	☐ WINDOW ENVELOPES
☐ ANNOUNCEMENTS	☐ COLLECTION HELPS
☐ APPOINTMENT CARDS	☐ INSTRUCTION SLIPS
☐ COURTESY CARDS	☐ PATIENTS' RECORDS
☐ CONTRACT CARDS	☐ BOOKKEEPING SYSTEMS
☐ REMINDER CARDS	☐ FILES AND SUPPLIES

America's Largest Printers to the Professions

BAKER CRISTOBALITE

INVESTMENT

UNIFORM EXPANSION OVER AN EXCEEDINGLY WIDE CASTING RANGE!

Baker Cristobalite Investment for inlays, bridges and large castings has a *uniform* expansion of from 1.2% to 1.3% over a broad temperature casting range! This is just what you need when making molds into which you cast precious metal alloys which shrink on an average of 1.25%.

You get maximum strength and smooth mold surfaces with Baker Cristobalite—and you'll find it washes away very easily under running water after casting.

Available through your dealer in 5, 15, 50 and 100 lb. containers.

BAKER

BAKER & CO., INC.
850 PASSAIC AVE. EAST NEWARK, NEW JERSEY

Mosby Books

TWO OUTSTANDING BOOKS BY SCHWEITZER THAT FORM A LOGICAL AND PRACTICAL SEQUENCE IN APPROACHING DENTAL PROBLEMS

ORAL REHABILITATION

By Means of Complete Occlusal Reconstruction in the Treatment of Dental Deformities and Related Subjects, Especially the Closed Bite.

Schweitzer tells the entire known story of adult human dentition—its varied deformities—their causes and *treatment.* He gives you step-by-step mechanics. Functional and anatomical techniques are described.

Represents twenty years of research and clinical work — profusely illustrated.

From the Reviews:

"Schweitzer has done it again. An excellent book."
—*New York University Journal of Dentistry, Jan. 1952*

"The reviewer feels that the author has made a real contribution to restorative dentistry. He brings together and edits an immense amount of research on the problem and discusses it from the practical viewpoint of the experienced clinician."
—*Pennsylvania Dental Journal, Oct. 1951*

"The book is well and extensively illustrated, and its message is that oral rehabilitation should, and can, be the objective of every practitioner. 'Oral Rehabilitation' presents a progressive step toward the practice of full mouth dentistry."
—*British Dental Journal, Dec. 1951*

"The book should be read by all those interested in conservative treatment of patients with impaired oral function due to deformities and the ravages of dental disease."
—*Harvard Dental Alumni Bulletin, Oct. 1951*

1161 pages, 1157 illustrations. Price, $20.00

RESTORATIVE DENTISTRY

An outstanding array of photographic material distinguishes this completely practical volume. The more than 1,000 illustrations represent accurate records of cases over many years. Clinical facts are emphasized, so there is little theoretical discussion. It is a fact-filled, practical book which every practicing dentist who does prosthetics will find valuable.

511 pages, 1014 illustrations. Price, $15.00

By JEROME M. SCHWEITZER, B.S., D.D.S., Consulting Dental Surgeon, Woman's Hospital, New York City; Postgraduate Instructor in Prosthetics, First District Dental Society, New York City; Associate Fellow New York Academy of Medicine; Fellow American Academy of Dental Medicine.

------ Order Form ----------

The C. V. MOSBY Company, 3207 Washington Blvd., St. Louis 3, Mo.

Please send me:

Schweitzer's ORAL REHABILITATION.....$20.00
Schweitzer's RESTORATIVE DENTISTRY.....$15.00

☐ Enclosed find check. ☐ Charge my account.

Name_____

Address_____

ADA 5-52

"WHAT HATH GOD WROUGHT"

Morse conceived the idea of telegraphy in 1832. However, it was not until 1844 that the first telegraphic message, "What hath God wrought," was sent from the chambers of the United States Supreme Court in Washington to a receiving set in Baltimore.

It is interesting to note that Morse, in his day, was as well known for his paintings as he was for his inventions. In his early days, his experiments were of secondary interest. He was the founder of the National Academy of Design and exhibited many portraits at the Royal Academy.

The business of Church & Dwight was started just two years after the sending of Morse's historic message. Since then our two brands—Arm & Hammer and Cow Brand—have stood for pure U.S.P. sodium bicarbonate.

Dentists have found no other dentifrice so useful in so many ways as pure sodium bicarbonate. Research has proved bicarbonate of soda an efficient dentifrice for L. Acidophilus reduction. Soda's gentle action cleans teeth safely . . . helps to whiten teeth to original shade without harm to enamel. When used as a gargle or rinse, it freshens the mouth.

Children's Storybooks. We have a series of approved, illustrated storybooks for children. If you would like a free supply for your waiting room, just write us.

Accepted
COUNCIL on DENTAL THERAPEUTICS
AMERICAN DENTAL ASSOCIATION

CHURCH & DWIGHT CO., INC.
10 Cedar Street • New York 5, N. Y.
Business Established in 1846

PLASTIC PARTIALS for YOUNG PEOPLE

In these cases — which often involve a bite that is SHORT or CLOSE — Steele's facings serve admirably to replace anterior teeth. (A Steele's facing is *thinner* in its labial-lingual dimension than a denture tooth.

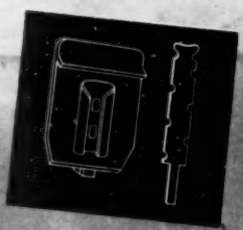
You simply cement the interchangeable Steele's facing to a Steele's *Denture Backing* embedded in the plastic denture material. Use reinforcing bars to give strength and rigidity to the narrow isthmus of denture material supporting one or two isolated teeth. Where a number of adjacent teeth are involved, the reinforcing bars are unnecessary. The technic is simple.

Steele's

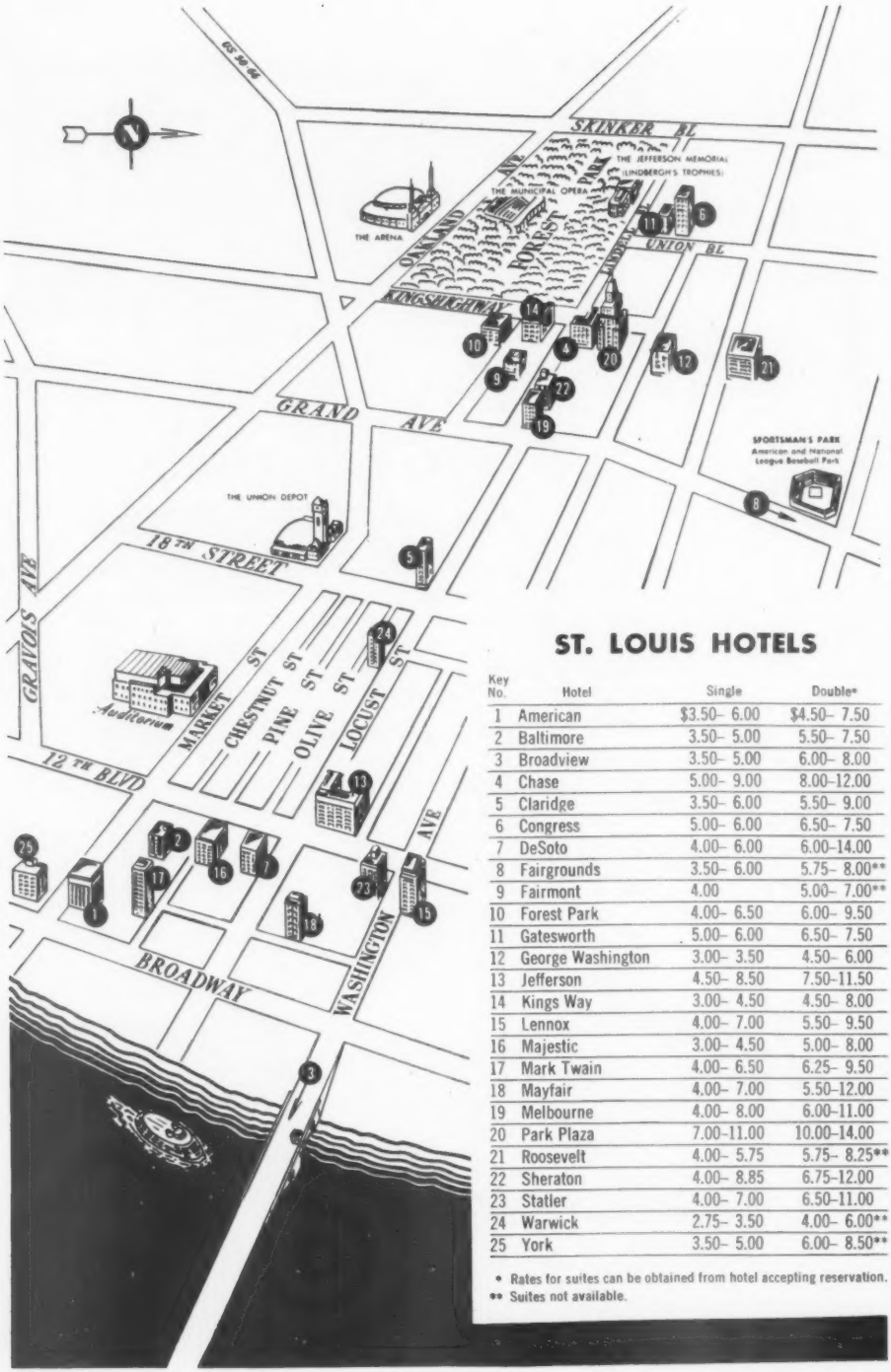
Interchangeable Facings

WITH

Denture Backings



THE COLUMBUS DENTAL MFG. CO. • COLUMBUS 6, OHIO



ST. LOUIS HOTELS

Key No.	Hotel	Single	Double*
1	American	$3.50– 6.00	$4.50– 7.50
2	Baltimore	3.50– 5.00	5.50– 7.50
3	Broadview	3.50– 5.00	6.00– 8.00
4	Chase	5.00– 9.00	8.00–12.00
5	Claridge	3.50– 6.00	5.50– 9.00
6	Congress	5.00– 6.00	6.50– 7.50
7	DeSoto	4.00– 6.00	6.00–14.00
8	Fairgrounds	3.50– 6.00	5.75– 8.00**
9	Fairmont	4.00	5.00– 7.00**
10	Forest Park	4.00– 6.50	6.00– 9.50
11	Gatesworth	5.00– 6.00	6.50– 7.50
12	George Washington	3.00– 3.50	4.50– 6.00
13	Jefferson	4.50– 8.50	7.50–11.50
14	Kings Way	3.00– 4.50	4.50– 8.00
15	Lennox	4.00– 7.00	5.50– 9.50
16	Majestic	3.00– 4.50	5.00– 8.00
17	Mark Twain	4.00– 6.50	6.25– 9.50
18	Mayfair	4.00– 7.00	5.50–12.00
19	Melbourne	4.00– 8.00	6.00–11.00
20	Park Plaza	7.00–11.00	10.00–14.00
21	Roosevelt	4.00– 5.75	5.75– 8.25**
22	Sheraton	4.00– 8.85	6.75–12.00
23	Statler	4.00– 7.00	6.50–11.00
24	Warwick	2.75– 3.50	4.00– 6.00**
25	York	3.50– 5.00	6.00– 8.50**

* Rates for suites can be obtained from hotel accepting reservation.
** Suites not available.

Hotel Reservation Application . . .

93rd Annual Session
American Dental Association
September 8-11, 1952
St. Louis, Missouri

A. D. A. HOUSING BUREAU

911 Locust Street, Room 406, St. Louis 1, Missouri

INSTRUCTIONS:

Reservations for hotel accommodations may be secured by completing this application and mailing it to: A.D.A. Housing Bureau, 911 Locust Street, Room 406, St. Louis 1, Missouri.

Be sure to indicate your arrival time in St. Louis. Reservations will be held only until 6 p.m. of the day you indicate when you will arrive in St. Louis. Failure to notify the hotel of any last minute change in your arrival time may result in cancellation of the reservation.

Names of all persons who intend to occupy the accommodations must be listed on the application.

List four choices of hotels.

Confirmation will be sent indicating which hotel has accepted the reservation.

Write the A.D.A. Housing Bureau in St. Louis if you wish to cancel the reservation or make any change in your reservation and NOT the hotel to which you were assigned.

(Please print or type) A.D.A.

Applicant:

Name_____

_____
(Street address) (City) (Zone) (State)

Arrival in St. Louis_____ a.m. p.m. Leaving_____

Accommodations:

Hotel_____ (First choice) Hotel_____ (Third choice)

Hotel_____ (Second choice) Hotel_____ (Fourth choice)

☐ Single occupancy, rate to range from $_____ to $_____ per day.

☐ Double occupancy, double bed, rate to range from $_____ to $_____ per day. } 2 names must be listed below

☐ Double occupancy, twin beds, rate to range from $_____ to $_____ per day. }

☐ Suite of_____ rooms, including parlor, rate to range from $_____ to $_____ per day.

Occupants: (use an extra page for listing additional names if necessary)

Room will be occupied by:

_____
(Name) (Address) (City) (State)

_____
(Name) (Address) (City) (State)

DEPTH WITHOUT DANGER

In an anesthetic *Safety* is the *First* consideration

Use Formula

2ME

Accepted Council on Dental Therapeutics American Dental Association

MONOCAINE 2% *with* Epinephrine 1:50,000

In Submarines "Depth without Danger" is of prime importance . . .

In local anesthesia too we must consider the relationship between safety and depth. A number of anesthetic drugs in excessive concentrations or combinations will produce deep anesthesia. So will cocaine. But all of these *"stronger"* anesthetics can induce toxic reaction and, in many instances, unpleasant postoperative sequellae.

Monocaine Formula 2ME (Monocaine 2% with epinephrine 1:50,000), on the other hand, produces anesthesia as deep as procaine 4%, yet its toxicity is appreciably less than that concentration of procaine.

Monocaine Formula 2ME was specifically developed for those cases in which anesthesia is difficult to obtain. While Monocaine 1½% is recommended for routine use, Monocaine Formula 2ME will be found to be particularly advantageous for jacket crown work, pulp extirpation and the preparation of bridge abutments.

MONOCAINE Formula 2ME *offers the anesthetist depth without danger—it combines adequate potency with maximum safety.*

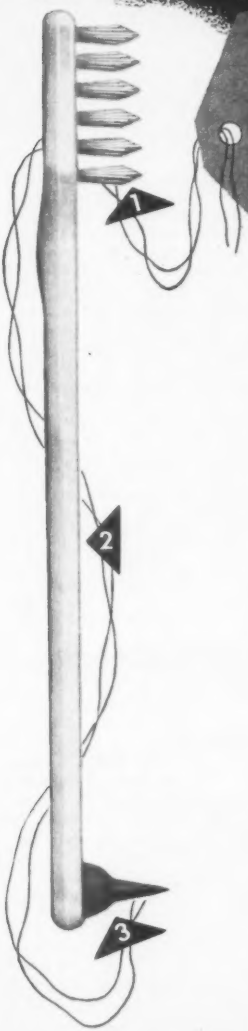
Monocaine is the registered trade mark of the Novocol Chemical Mfg. Co., Inc.

NOVOCOL CHEMICAL MFG. CO., INC.
2911-23 Atlantic Ave. Brooklyn 7, N. Y.

only

PY-CO-PAY TOOTHBRUSH

offers all 3!



1. **Natural bristles "Duratized"** for longer life. Bristles reinforced by special process to assure "flexible stiffness," resist matting for longer periods... outlast ordinary brushes up to 3 times.

2. **Straight-line design** to meet professional preference. Straight-trimmed bristle tufts, straight shank, straight handle... for simpler, more efficient manipulation.

3. **Py-co-tip** for interdental stimulation. Flexible, resilient rubber construction... ready for your patient's use according to your instructions, to reach interproximal spaces inaccessible to the toothbrush.

Pycopé, Inc. · Jersey City 2, New Jersey

Py-co-pay *The Ultimate in Design, Efficiency, Longevity*

RECOMMENDED BY MORE DENTISTS THAN ANY OTHER TOOTHBRUSH

TWO WELCOME AIDS FOR THE BUSY PRACTITIONER

BY SAMUEL CHARLES MILLER, D.D.S., F.A.C.D.
Professor of Periodontia, Chairman of the Department of Periodontia, New York University College of Dentistry

NEW 3rd EDITION! PERIODONTIA

"Cannot be too highly recommended to dental practitioners, both young and old. In fact, no dental practitioner who is worth his salt can afford to be without this."—*Dental Items of Interest.*

Here is one of the most comprehensive, *clinical* treatments of the new science of Periodontics. The author and 34 contributors present the experience gained from 50,000 case histories in the world's largest periodontic clinic. The result is an accurate, comprehensive guide to diagnosis and treatment, based on the most recent technics, procedures and concepts.

It includes instructions for conservative and surgical treatment of periodontal pockets—six operations with full details written by the originators of each recognized technic. There is a complete chapter devoted to presenting periodontia to the patient. Additional new chapters have been written on "Psychosomatic Factors" and on "Periodontial Disease in Children." The abundance of excellent illustrations, with many new ones added, helps to demonstrate vividly the technics and procedures.

586 Illustrations • 900 Pages **$11.50**

ORAL DIAGNOSIS AND TREATMENT

2nd Edition

"There is no more important phase of dentistry than that of oral diagnosis. This book is well illustrated . . . well done . . . a valuable addition to any library—institutional or personal."—*Journal of the American Dental Association.*

"PRACTICAL" would be one of the best words to describe this standard, authoritative reference. Throughout the book, the author and 30 clinician-contributors integrate modern advances in medicine and dentistry for more effective diagnosis and treatment.

The busy practitioner will appreciate the clear and concise presentation of this important subject matter. With the growing emphasis on treatment, material is included on Aerodontia, Diseases of the Salivary Glands and Roentgenographic Interpretation. There is a chapter on the Latest Technic on Extra-Oral Fixation for Mandibular Fractures Developed in World War II. All in all, here is a wealth of practical, *usable* material that can be utilized immediately in daily practice. The numerous illustrations including 39 plates in color, are unusually helpful in establishing better understanding of the material.

574 Illustrations • 39 Color Plates
903 Pages **$10.00**

USE THIS CONVENIENT COUPON TO ORDER YOUR COPIES TODAY!

The Blakiston Company
1012 Walnut Street
Philadelphia 5, Pa.

THE BLAKISTON COMPANY
1012 Walnut Street — Philadelphia 5, Pa.
105 Bond Street — Toronto 2, Canada

Please send me the following books. ☐ Check enclosed; ☐ Charge my account. It is understood you will credit my account in full for any book I return within 10 days.

☐ PERIODONTIA—3rd Edition
☐ ORAL DIAGNOSIS AND TREATMENT—2nd Edition

Name_____
Address_____
City_____ Zone____ State_____

J.A.D.A. 5-52

ACRALITE

*Only fastcrown prescribes the true non-pressure compensating brush technique**

— which, by warming the powder compensates for volume loss during polymerization . . .

ACRALITE
fastcrown
FILLING PLASTIC

The major purpose of the Non-Pressure Compensating Brush Technique* is to compensate for volume loss during polymerization! Only FASTCROWN, of all the fine particle size filling plastics, is suitable for the *true* Non-Pressure Compensating Technique.* Compensation is obtained by inserting a small bead of the material, inducing it to cure as rapidly as possible, undergoing its loss of volume. When the next bead is added, it compensates for the loss of the first portion and then, in turn, polymerizes. *Compensation for shrinkage is commensurate with the degree of polymerization attained in the first portion before the second is inserted.* The *true* Compensating Technique* used with FASTCROWN provides this maximum polymerization.

ONLY *fastcrown* OFFERS ALL THESE ADVANTAGES

- FASTCROWN restorations are superior, no matter what technique may be used.
- FASTCROWN cures as fast; uses less liquid.
- FASTCROWN has less shrinkage.
- FASTCROWN is non-irritating to the pulp.
- FASTCROWN possesses color stability.

An important 20-page booklet on FASTCROWN and the Non-Pressure Compensating Technique* is available on request.

*Developed by Dr. Frank H. Nealon

ACRALITE SUPERIOR PRODUCTS for MODERN DENTISTRY
ACRALITE CO., Inc. 230 WEST 41st ST., N Y 36, N. Y.

Prices Drastically Reduced!

FOR 30 DAYS ONLY! **ORDER AT ONCE**

FINEST QUALITY IMPORTED BURS

ROUND	Sizes ½ to 8	$5.95 Gross
INV. CONE	Sizes 33½ to 41	5.95 Gross
C. C. FISSURE	Sizes 557 to 560; 700 to 702	7.95 Gross

For Right Angle or Hand Piece

Same quality as Burs selling for $12.00 and $14.00 gr

Imported Chrome Plated, Contra Angle for Doriot		$ 4.95
Imported Chrome Plated, Doriot Hand Piece		14.50
100 "STANDARD" Anesthetic TUBES—(Accepted A.D.A.) (Formulas 2A and 1AB)		3.95
Chrome Plated, U.S.A. Make, Right Angle for Doriot		5.95
Chrome Plated, U.S.A. Make, Contra Angle for Doriot		9.95
Chrome Plated, U.S.A. Make, Doriot Hand Piece		19.45
12 GUARANTEED BOILABLE MIRRORS (Sizes 4-5-6 Plain or Mag.)		3.50
IMPORTED FORCEPS (Chrome-Plated)	Each	3.45
(Nos. 15, 16, 18L, 18R, 32, 53L, 53R, 65, 69, 85, 88L, 88R, 150, 151) (Stainless Steel)	Each	6.25
Diamond Instruments—Nos. 1-2-7-18-25-26-32-35-75-76-87	Each	1.75
5 ozs. STANDARD ALLOY (69% Silver, 25% Tin, 5% Copper, 1% Zinc) A.D.A. Accepted		7.50
100 Assorted Copper Bands (½" x 36G) 20 Sizes in box		1.75
24 Steel MANDRELS for Hand Piece $1.50 ..... 24 For Right Angle		2.00
6 Assorted VULCANITE BURS (Round, Bud, Pear, Egg)		1.75
IMPORTED No. 1 Matrix Retainer (Chrome Plated)		1.75
1200 Sand Paper Disks (½" and ¾") Assorted		1.00
2 Jars Floss in Glass Containers (150 Yards)		1.25
12 Carborundum Mounted Points (Assorted)		1.25
2 Chrome Plated Clogless Saliva Ejectors		1.25
2 Dozen Steel Disks (⅜"-¾"-⅞") or Steel Strips		1.00
6 Dozen Broaches		1.50
200 No. 2 Record Cards, Size 4" x 6"		1.00
4 Stainless Steel P. W. Explorers (3-6-17-23)		1.00
6 Boxes Celluloid Strips		1.00
5 Boxes Temporary Stopping		1.00
Box of S. S. White Porcelain, Shades 20-23-24-25-27-28		1.00
30 Assorted Heatless Wheels (Sizes 4 to 12)		1.00
20 Books Articulating Paper		1.00
50 Assorted Pumice Rubber Cleaning & Polishing Wheels—Cups		1.00
4 Assorted Dappin Dishes (Amber, Blue, Green, Clear)		1.00
3 Napkin Holders		1.00

TERMS: Check with order—or C.O.D. (C.O.D. Fees extra)
Parcel Post Prepaid—TO YOUR OFFICE
Include Business Card or Letter Head with order

FREE!—Gent's Leather Billfold—with $10.00 order—FREE!

HURRY if you want any of these SENSATIONAL VALUES
MAIL YOUR ORDER AT ONCE—BEFORE IT IS TOO LATE

STANDARD DENTAL PRODUCTS CO.

908 Chestnut St. **Philadelphia 7, Pa.**

ABSOLUTE SATISFACTION or YOUR MONEY BACK

INSURANCE

FOR DENTISTS, PHYSICIANS, SURGEONS EXCLUSIVELY
Accident • Hospital • Sickness

ALL PREMIUMS COME FROM — PHYSICIANS SURGEONS DENTISTS — ALL BENEFITS GO TO

Cost has never exceeded amounts shown

$5,000.00 ACCIDENTAL DEATH $25.00 weekly indemnity, accident and sickness	**$8.00** Quarterly
$10,000.00 ACCIDENTAL DEATH $50.00 weekly indemnity, accident and sickness	**$16.00** Quarterly
$15,000.00 ACCIDENTAL DEATH $75.00 weekly indemnity, accident and sickness	**$24.00** Quarterly
$20,000.00 ACCIDENTAL DEATH $100.00 weekly indemnity, accident and sickness	**$32.00** Quarterly

Also hospital expense for members, wives and children at small additional cost

85c out of each $1.00 gross income used for members' benefit

$4,000,000.00
INVESTED ASSETS

$18,300,000.00
PAID FOR CLAIMS

$200,000.00 deposited with State of Nebraska for protection of our members

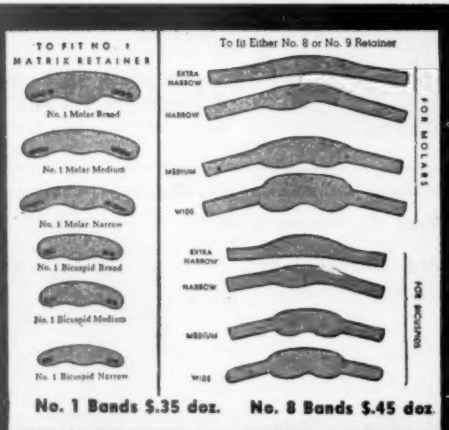
Disability need not be incurred in line of duty—benefits from the beginning day of disability

PHYSICIANS CASUALTY ASSOCIATION
PHYSICIANS HEALTH ASSOCIATION

50 years under the same management

400 FIRST NATIONAL BANK BUILDING — **OMAHA 2, NEBRASKA**

Don't Say Matrix Bands, Say UBECO EXTRA-THIN STAINLESS SPRING STEEL MATRIX BANDS



The difference in cost between steel and STAINLESS steel matrix bands is so trivial, it pays to insist on these.

Made for Dentists who want the BEST!

Made to fit No. 1, 8, or 9 Retainers. They are stronger, tougher, cleaner, smoother, accurately machined.

Manufactured by

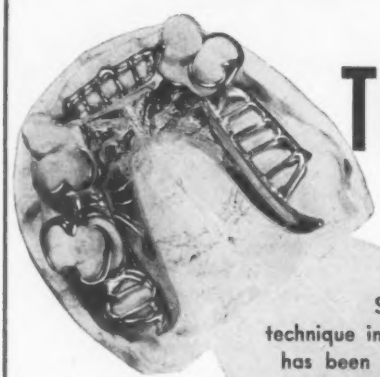
No. 1 Bands $.35 doz. No. 8 Bands $.45 doz.

UNION BROACH CO., INC. 37 West 20th St., New York 11, N. Y.

BLUE RIBBON PROSTHETICS

with the New Thompson

TRU-RUGAE



Selected by doctors as the finest technique in many years — the TRU-RUGAE has been praised at dental meetings — in doctors' offices. Available on both full and partial upper dentures — TRU-RUGAE actually reproduces the rugae area on both the tissue and tongue side. Ask your Ticonium laboratory about the Thompson TRU-RUGAE!

For new developments . . .

look to

TICONIUM

413 N. Pearl St., Albany 1, N. Y.

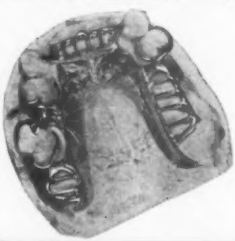
TICONIUM 413 N. Pearl St., Albany 1, N. Y.

Please send me detailed information on the Thompson TRU-RUGAE technique.

Dr.....

Street.....

City.....Zone.....State.....



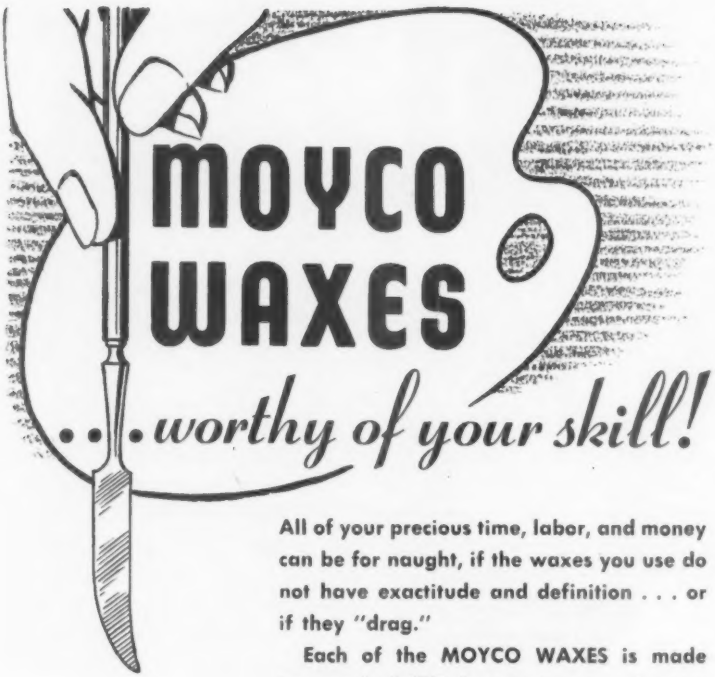
"...and don't forget the VITAMINS!"

During the formative stage of tooth development, vitamins play an essential role in mineral and bone deposition.

A balanced vitamin preparation is assurance that the patient will receive her needed daily vitamin intake.

MERCK & CO., INC., Rahway, N.J.—as a major manufacturer of Vitamins, serves the Dental Profession through the Pharmaceutical Industry

MERCK



All of your precious time, labor, and money can be for naught, if the waxes you use do not have exactitude and definition . . . or if they "drag."

Each of the MOYCO WAXES is made to *exactly* fulfill the requirements for any special phase of inlay, crown and bridge, or prosthetic technics.

MOYCO WAXES are made from the finest materials available . . . in one of the most modern wax factories in all the world.

You can be certain that all your skills will be perpetuated . . . . when you use MOYCO WAXES.

at your dealer

Beauty Pink Base Plate Wax • Base Plate Wax (Pink, Yellow, Neutral) • Bite Wax (in cakes, thin sheets, base plate size) • Boxing Wax—green and red; Black Carding Wax • Pink Casting Wax • Counter Wax • Inlay Wax (in cones: blue or green; in sticks: blue, green or neutral) • Set-Up Wax • Sticky Wax • Utility Wax.

J·B M CO. INC.

THE J. BIRD Moyer CO., INC.

117-21 N. FIFTH STREET PHILADELPHIA 6, PA.

in penicillin therapy of oral infections...

optimal
CONCENTRATION
and
EXPOSURE TIME

ORYGENE®

penicillin chewing troches

Parke-Davis

In a recent review on the use of antibiotics in oral therapeutics, Dobbs and Eskow* state that for best results, "The concentration of drugs must be adequate at the site of the infection . . . The exposure time must be adequate to produce the desired effect on the pathogens."

Each ORYGENE Penicillin Chewing Troche contains 20,000 units of penicillin in a palatable chewing gum base which assures fulfillment of *both* these requirements. The gradual release of penicillin provides steadily maintained concentrations of the antibiotic "at the site of the infection," while the peppermint-flavored chicle gum base encourages mastication throughout the recommended half-hour chewing period, insuring optimal "exposure time."

Dosage and Method of Use. One ORYGENE Troche should be chewed at a time, preferably for 30 minutes. In treating infections caused by Vincent's organisms, a daily total of 4 to 6 troches will usually produce clinical results within 24 to 48 hours, although precautionary treatment should be continued for several days thereafter. It may be necessary to supplement ORYGENE by parenteral administration of penicillin, or by other measures as indicated.

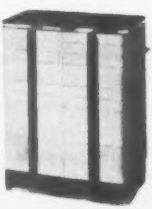
Packaging. Each ORYGENE Troche is individually and hermetically sealed in metal foil—no refrigeration necessary. Available on prescription in packages of 12.

Dobbs, E. C., and Eskow, A. B.: The Use of Antibiotic Therapy In Oral Therapeutics, New York J. Dent. *21*:459 (Dec.) 1951.

MEDICAMENTA VERA · PD CO.

Parke, Davis & Company

Will any other investment yield as much Professional *satisfaction-per-dollar*... year after year?



American Mobile Cabinet No. 176 Ideal for seated operating

The American Cabinet Company

Division of Hamilton Manufacturing Company
TWO RIVERS, WISCONSIN

FIRMILAY

This JELENKO PRECISION CASTING GOLD is the gold of choice for Carmichaels and all Crown and Inlay Abutments. Firmilay castings are clean, sharp, precise. They have ample strength and hardness, plus a high burnishability in the quenched condition, assuring ease in finishing margins. ¶ Also recommended for short span stationary bridges when properly heat hardened.

Cast by THERMOTROL

J. F. Jelenko & Co., Inc.

136 West 52nd Street • New York 19, U. S. A.

Valuable silver pieces require special cleaning and polishing agents to preserve their impressive beauty. Expensive dentures call for equally cautious care.

steel wool that precious

To forestall a haphazard choice of cleansing method by denture patients, many dentists recommend Wernet's Dentu-Creme and Wernet's Plate Brush. Dentu-Creme is smooth, absolutely non-injurious, and an unexcelled detergent ... ideal for use on acrylics because of its special polishing agent. Wernet's Plate Brush with the Easy-Grip Handle conforms to professional specifications. Its divided tufts of fine bristles are individually wired-in for long life. Its black bristle section is used on the ridge and vault ... white bristle section on the teeth and interproximal surfaces. For safe yet thorough removal of mucin plaques, food particles, and stubborn stains, recommend Wernet's Plate Brush and Wernet's Dentu-Creme.

WERNET DENTAL MANUFACTURING CO., INC
Jersey City 2, N. J. **Dept. 6-I**

WERNET'S DENTU-CREME
and
WERNET'S PLATE BRUSH

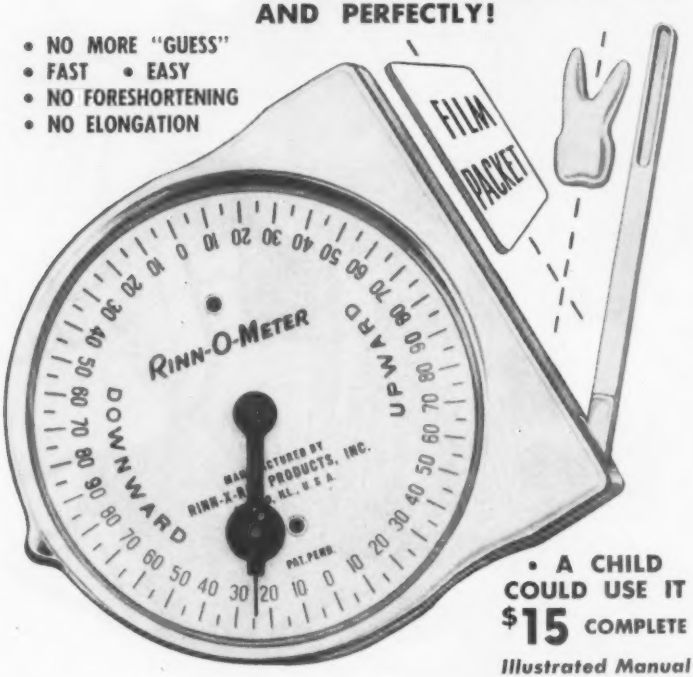
Sterling?

464

NEW—GINGIVAL TECHNIC

● SIMPLE COMPUTER ANGULATES X-RAY CONE AUTOMATICALLY AND PERFECTLY!

- NO MORE "GUESS"
- FAST • EASY
- NO FORESHORTENING
- NO ELONGATION



- A CHILD COULD USE IT

$15 COMPLETE

Illustrated Manual FREE on Request

3 simple steps . . . for better pictures . . . time saved, too! **1.** Line up visually (outside mouth) meter's edge with film packet . . . movable arm with tooth's long axis. **2.** Read dial pointer, set cone as indicated on meter (e.g. 25 degrees).

3. Aim central ray or cone tip to *gingival margin* and expose. A simple 1-2-3 routine that's faster. No tedious 2nd and 3rd "tries" at proper setting of patient and X-Ray before shooting. Amazing results in consistently accurate tooth shadow.

RINN X-RAY PRODUCTS Inc.

2929 N. CRAWFORD AVENUE • CHICAGO 41, ILLINOIS

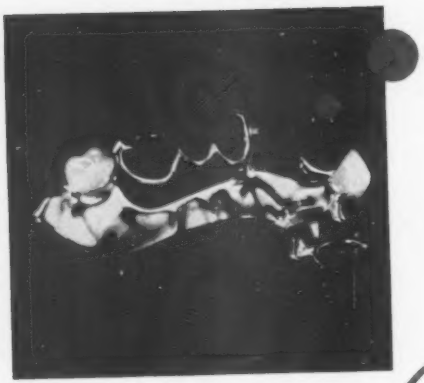
...filling material of improved endurance
lifelike appearance...simple technic!

DIAFIL

Here's every quality you want in a durable, dependable material for anterior and posterior fillings and for the restoration of broken down molars and bicuspids. Complies with A.D.A. Specification #9.

PFINGST & COMPANY, INC. • 62 COOPER SQUARE NEW YORK 3, N. Y.

BUSCH BURS • HORICO DIAMOND ABRASIVES • AJUSTO HAND PIECES • STAINLESS INSTRUMENTS



FOR 20 YEARS
1932-1952

First

VITALLIUM®

® by Austenal Laboratories, Inc.

AUSTENAL LABORATORIES, INC.
NEW YORK • CHICAGO

THERE IS A VITALLIUM LABORATORY NEAR YOU

Ever since the introduction of the Vitallium Technique to the field of dental prosthetics 20 years ago, it has been the pace setter in providing the profession with finer cast full and partial dentures, lighter in weight, more precise and intricate in detail, more exact in fit and adaptation.

The quality controls inherent in the technique, developed and perfected by Austenal and applied by your Vitallium Processing Laboratory, are a safeguard to your professional

IN PRECISION CASTING TECHNIQUE

FOR BETTER FULL AND PARTIAL DENTURES

ethics and interests, and a guarantee that you will receive genuine Vitallium appliances which eliminate uncertainty and enrich your practice.

Prescribe Vitallium full and partial dentures through your Vitallium Laboratory. Be sure they are genuine.

VITALLIUM®

. . . and invest a minute in comparing the many fine qualities of Crescent Stopping with any temporary stopping at any price . . .

Crescent Stopping is made of the finest gutta percha.

It adheres to cavity walls; will NOT contract. It retains form indefinitely. Withstands attrition and temperature of mouth. Will not irritate tissue; leaves NO taste. But it will soften, when you're ready, at low temperature and is easily removed.

Has MANY uses: filling cavities temporarily, sealing in medicaments, filling root canals permanently, lining cavities and as a separation. What's more it's *guaranteed* to *satisfy you* or your money back no questions asked.

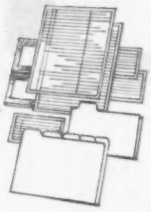
4 oz. jar

Crescent
DENTAL MFG. CO.
1839 S. Pulaski Rd.
Chicago 23, Ill.

Order today

Companions to a Successful Practice...

COLWELL
RECORD SUPPLIES
for
DENTISTS



Developed by the originators of the DAILY LOG . . . specialists in professional record supplies since 1927.

Your choice of a wide variety of economically priced and attractively designed Dental Charts and Ledger Cards.

Also File Envelopes, File Indexing, Professional Stationery, Appointment, Professional and Announcement Cards, Record of Payments, Appointment Log and many other record supplies you need for a better organized practice.

Send for FREE Catalog

COLWELL PUBLISHING CO.
262 University Ave.
Champaign, Ill.

Please send me the COLWELL CATALOG of Dentists' Record Supplies.

Name .....

Address .....

.....

Confidence...

in your dentures

The new denture patient has confidence in your dentures ... and in your professional skill and integrity. That confidence can be strengthened by the prescription of Co-re-ga, which so effectively facilitates a quicker and more comfortable adjustment to proficiency with dentures.

CO-RE-GA
IS NOT ADVERTISED
TO THE PUBLIC

Co-re-ga

Accepted
COUNCIL on DENTAL THERAPEUTICS
AMERICAN DENTAL ASSOCIATION

Please send complimentary professional samples.

Dr._____
PLEASE PRINT

Address_____

City_____ Zone____ State_____

22-E

COREGA CHEMICAL CO. • 76 MILL ROAD • JERSEY CITY 2, N. J.

S.S.WHITE Tarno

Factory proved.....

.....NON-

Every S. S. White Tarno brand instrument is tested and inspected individually for resistance to rust, stain, and discoloration before it leaves our factory. A steel can be rustless, yet not stainless. Resistance to stain is developed in instruments by expert treatment during their manufacture. All Tarno instruments receive this treatment, and to make certain they are stainless, each is subjected to a copper-sulphate-sulphuric-acid-water bath. This is, in our opinion, the most rigid test for resistance to rust, stain, and discoloration. Tarno instruments must and do pass it successfully before you receive them. A steel instrument marked Tarno is really stainless.

"Tarno" is a trade-mark registered in the U. S. Patent Office and elsewhere, and is applied solely to S. S. White products made of metals resistant to tarnish and discoloration.

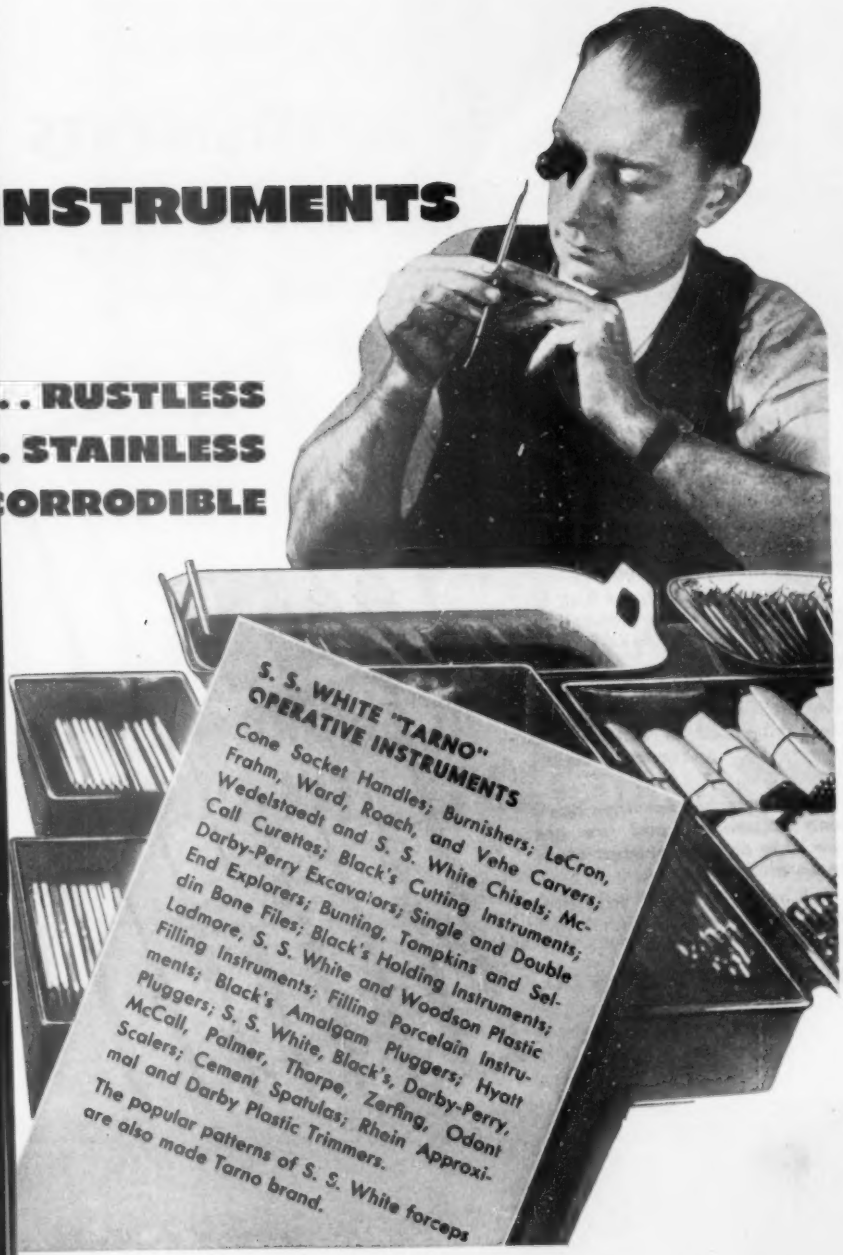
for sale by your dealer

THE S.S.WHITE DENTAL MFG. CO.
211 South 12th Street, Philadelphia 5, Pa.

"OVER A CENTURY OF SERVICE TO DENTISTRY"

INSTRUMENTS

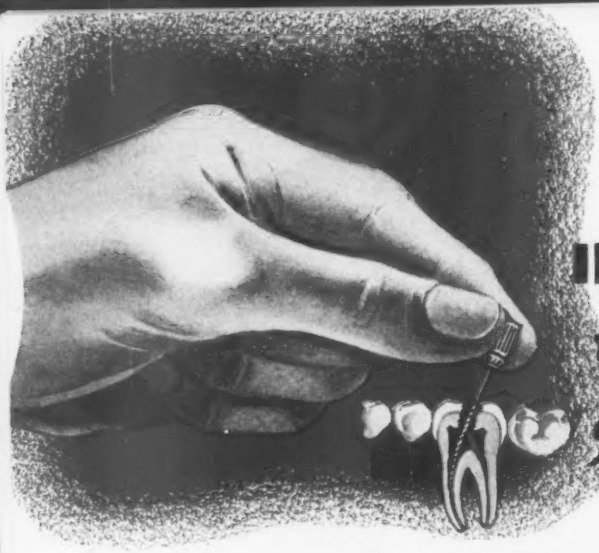
. . RUSTLESS
. STAINLESS
CORRODIBLE



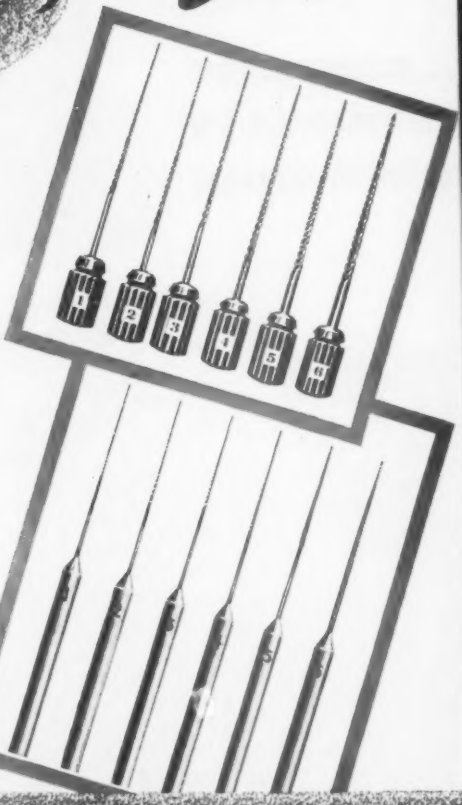
S. S. WHITE "TARNO" OPERATIVE INSTRUMENTS

Cone Socket Handles; Burnishers; LeCron, Frahm, Ward, Roach, and Vehe Carvers; Wedelstaedt and S. S. White Chisels; McCall Curettes; Black's Cutting Instruments; Darby-Perry Excavators; Single and Double End Explorers; Bunting, Tompkins and Seldin Bone Files; Black's Holding Instruments; Ladmore, S. S. White and Woodson Plastic Filling Instruments; Filling Porcelain Instruments; Black's Amalgam Pluggers; Hyatt Pluggers; S. S. White, Black's, Darby-Perry, McCall, Palmer, Thorpe, Zerfing, Odont Scalers; Cement Spatulas; Rhein Approximal and Darby Plastic Trimmers.

The popular patterns of S. S. White forceps are also made Tarno brand.



INSTRUMENTS *worthy of your Skill*



Pulp canal operations are delicate and exacting. Only instruments of highest quality and most advanced design can make good your skill in this important department of operative dentistry.

It's no mere coincidence that, for pulp canal work the world over, dentists standardize on Kerr Reamers and Files.

Reason for this is that each instrument is carefully tempered and has keen cutting edges extending to its very tip. And each is rigidly inspected.

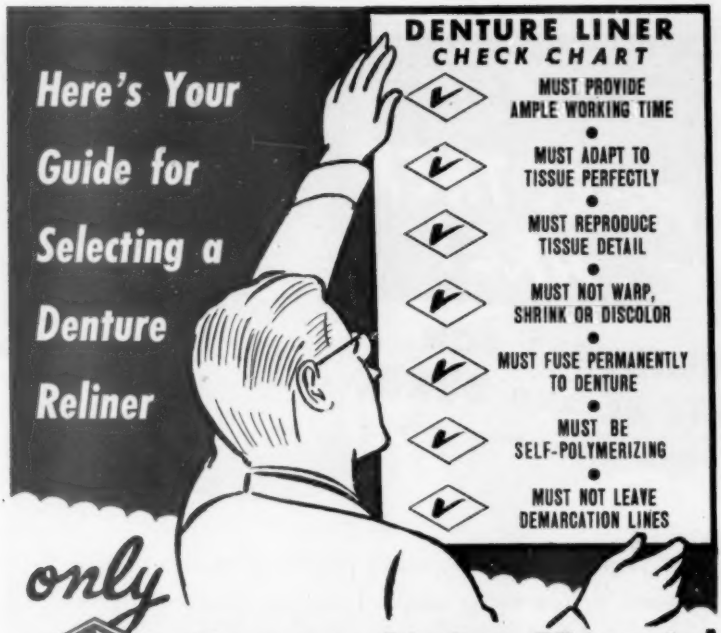
Manufacturing facilities have been expanded and we are now able to give prompt service on all orders.

Call your Dealer for these precision instruments—instruments that are worthy of your skill.

KERR MANUFACTURING CO.
Detroit 8, Michigan
Established 1891

KERR
REG. U.S. PAT. OFF.

PULP CANAL INSTRUMENTS

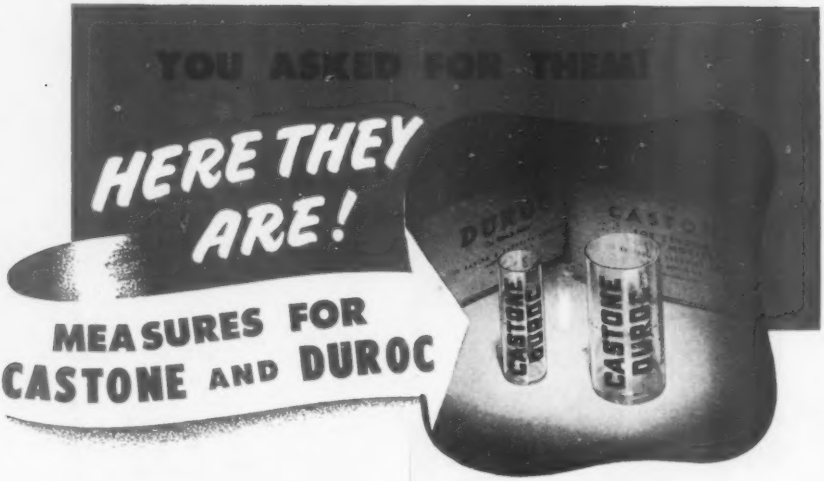

Here's Your Guide for Selecting a Denture Reliner
DENTURE LINER
CHECK CHART
MUST PROVIDE AMPLE WORKING TIME
MUST ADAPT TO TISSUE PERFECTLY
MUST REPRODUCE TISSUE DETAIL
MUST NOT WARP, SHRINK OR DISCOLOR
MUST FUSE PERMANENTLY TO DENTURE
MUST BE SELF-POLYMERIZING
MUST NOT LEAVE DEMARCATION LINES

only ORYL Denture Lining Material is available in Combination "DUO-KIT" (CLEAR & PINK) Only $7.50

Now . . . a new ALL-PURPOSE economy package of ORYL Denture Lining and Repair Material. Comes in a compact kit containing 2 ounces of *BOTH* CLEAR and PINK material (enough for 25 to 30 complete relines), 3 ounces of liquid, 2 measuring cups and a mixing jar . . . all ready for ANY denture rebase or repair. The same easy-to-use, fast, one-visit top QUALITY material now used by thousands of dentists and laboratories with complete patient satisfaction. Made by a pioneer producer of lining materials. Get this new *low cost, all-purpose* DUO-KIT now.

ORDER FROM YOUR DEALER TODAY!

THE WILLIAM GETZ CORPORATION
DENTAL PRODUCTS
7512 GREENWOOD AVE. • CHICAGO 19, ILLINOIS



A pair of durable, heavy plastic powder-and-water measures is now being supplied without charge in every container of R & R CASTONE and DUROC.

They save time—reduce waste! By insuring the correct mix they minimize risk of rough, porous or brittle models.

But we can continue to include the measures in Castone and Duroc containers only as long as our supply lasts. So order from your dealer immediately.

TOPS IN THEIR FIELDS!

CASTONE

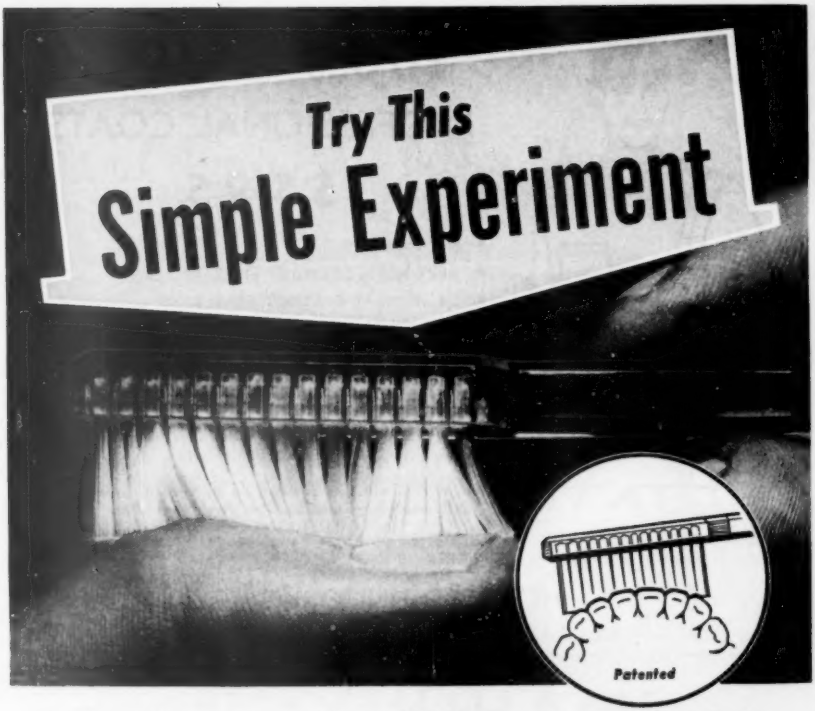
The extra-tough all-purpose model stone. Cream-color or pure white.

DUROC

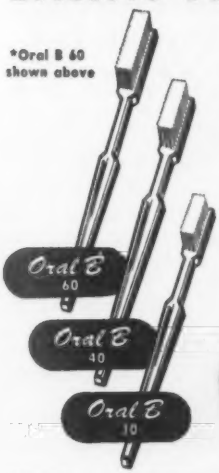
Super-hard; super-accurate—for partial models, dies, etc. Lime-yellow color.

R&R

THE RANSOM & RANDOLPH CO.
TOLEDO, OHIO



See how easily 2500 softer Oral B bristles reach irregular surfaces!



*Oral B 60 shown above

3 SIZES . . . 1 TEXTURE

Just place the Oral B on your thumb, as shown above, and use a gentle brushing motion. Notice how the smaller, closely packed bristles contact the entire surface. This same action takes place in the mouth. Interproximal spaces are reached far more effectively due to the use of more bristles of the proper size and texture.

This *original* multi-tuft, soft bristle brush* contains *3 times more bristles* than an ordinary brush—and many more than any similar brush. The result is superior cleansing of tooth structure without abrasion, plus gingival massage without injury. Try an Oral B and feel the difference!

Write today for complete information

Oral B® Company

315 SOUTH FIRST STREET
DEPT. C SAN JOSE 13, CALIF.

100% NYLON
PROFESSIONAL COATS
$5.95

- NO PRESSING
- SAVE HIGH LAUNDRY BILLS
- CRISP, NEAT & COMFORTABLE
- LAST YEARS

WHITE — TAN — NAVY

SIZES 34-46 (Order same size as jacket you are now wearing.)

CONCEALED BUTTONS

*HOWARD will pay postage on all prepaid orders. Save C.O.D. charges by sending Check or Money Order TODAY.

*MONEY BACK GUARANTEE (If you are not positively delighted your money will be refunded if returned in original condition within 10 days).

HOWARD UNIFORMS

105-01 NORTHERN BOULEVARD CORONA, N.Y.

LEA & FEBIGER BOOKS

NEW—JUST PUBLISHED

Grossman—Dental Formulas

And Aids to Dental Practice

By LOUIS I. GROSSMAN
D.D.S., Dr. med. dent.
Associate Professor of Oral Medicine, The Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania

New. This book stands alone in the dental field for its value to dentists and to all others interested in the broad subject. There are several hundred formulas, including numerous original ones; many that appear in print for the first time; and formulas of dental materials which can be prepared at a fraction of the cost of commercial preparations. There are many useful diagnostic tables.

New. 318 Pages. 25 Illustrations 1 in color. 19 Tables. $5.00

NEW 5th EDITION

McBride—Juvenile Dentistry

By WALTER C. McBRIDE
D.D.S., F.A.C.D.
Formerly Associate Professor of Operative Dentistry and Director of the Department of Pedodontics, School of Dentistry, University of Detroit; AND CONTRIBUTORS

New 5th Edition. Dr. McBride shows how dentists can apply the technics of juvenile dentistry and thus form the foundation of a profitable practice. In this revised and fully up to date *new 5th edition,* emphasis is on management of children; on the elimination of devitalized and abscessed teeth and lost fillings; and preventive dentistry. Many new and important features have been added.

New 5th Edition. 370 Pages 302 Illustrations. $7.00

Washington Square **LEA & FEBIGER** Philadelphia 6, Pa.

TWO *are better than* **ONE** . . .

and three are better than two!

Such a simple "rule of thumb" in regard to x-ray equipment has proved highly advantageous for an increasing number of dentists. More and more dentists with multiple operating rooms have discovered that a Ritter DUAL-X in each room makes their practice easier . . . speeds patient examinations. More patients are handled with greater efficiency. These dentists have found, too, that each additional Ritter DUAL-X x-ray has proved to be a wise and profitable investment.

Be sure you are equipped to offer the best in dental radiography. Ask your Ritter dealer for a Ritter DUAL-X demonstration today.

BETTER DENTAL RADIOGRAPHY WITH

THE NEW RITTER *Dual-X*

the company you keep counts

When you "keep company" with Johnson & Johnson you enjoy efficacy and elegance in dental technique, for J. & J. research and control assure uniformly finest quality in dental operative aids and sanitary accessories.

DENTAL DIVISION

Johnson & Johnson

no more guesswork
in impression taking!

DP elastic impression cream with

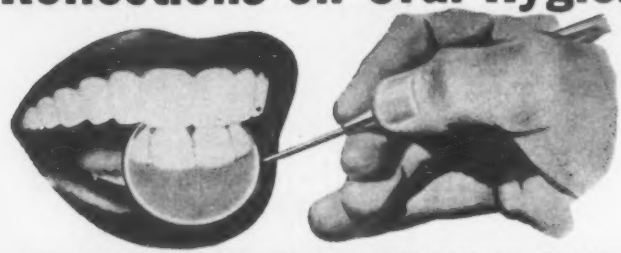
CHROMATIC TIMING

OFFERS YOU *elasticity, strength* and *accuracy* so far beyond anything you have ever experienced that you must see it to appreciate what it can do for *you!*

Ask Your Dental Salesman for Details

dental perfection co.

Reflections on Oral Hygiene



IT'S WHAT YOU DO AT THE CHAIR, DOCTOR

PLUS

WHAT YOUR PATIENT DOES AT HOME THAT ADDS UP TO SOUND ORAL HYGIENE

IPANA®
PRODUCT OF BRISTOL-MYERS • 19 WEST 50 STREET, NEW YORK 20, N.Y.

for oral lesions due to vitamin B and C deficiencies

Vitetrin

Basic Formula Vitamin Tablets Squibb

Vitetrin (formerly Basic Formula Vitamin Tablets Squibb) supplies therapeutic doses of four critical water-soluble vitamins essential for correction of oral lesions caused by B and C deficiencies. Vitetrin is a clinically proved formula as described and used by Jolliffe and Spies. (Thiamine content raised to 10 mg.)

Each Vitetrin Tablet supplies:

Thiamine Mononitrate	10 mg.
Riboflavin	5 mg.
Niacinamide	150 mg.
Ascorbic Acid	150 mg.

Dosage: 1 or 2 tablets daily.
Supply: Bottles of 30, 100 and 250.

VITETRIN® IS A TRADEMARK OF E. R. SQUIBB & SONS

SQUIBB

Your skill plus prompt laboratory service...

...wins your patients' Warmest appreciation!

Because speed is so important in so many prosthetic cases, laboratory service is a tremendous advantage to busy dentists everywhere. *And* to their patients, who appreciate prompt attention! Laboratory service, in turn, depends on *good materials*. That's why so many laboratories prefer to work with *Lucitone*.

Lifelike appearance. Lucitone's mottled, translucent "tissue texture" permits a higher degree of individuality.

Strength. More than ample to withstand all normal shocks and stresses, in both full and partial dentures.

Lasting fit. Lucitone's dimensional stability is always dependable.

Workability. Free from all technic restraints that may lead to inaccuracies in construction.

you're sure when you specify

LUCITONE

For progress in plastics, talk to *Caulk* Milford, Del.

Lucitone is the trade-mark of the acrylic denture material manufactured exclusively for dentistry from Du Pont resins.

DENTISTS EVERYWHERE

ARE ENTHUSIASTIC OVER

THE RADIOSURG

Indicated in the NEW Science of MOUTH RECONSTRUCTION TECHNIQUES

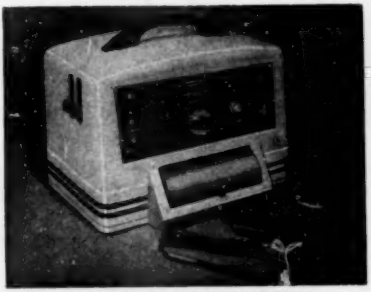
INDISPENSABLE AS AN AID IN

- CROWN AND BRIDGE TECHNIQUES
- HYDROCOLLOID TECHNIQUES
- GINGIVOPLASTY
- PERIODONTIA TECHNIQUES
- PROSTHETIC TECHNIQUES
- RESTORATIVE TECHNIQUES
- ORAL SURGERY

AND

FOR MANY OTHER APPROACHES DESIGNED TO FACILITATE YOUR PRACTICE. Write for detailed description and AUTHORITATIVE REPRINTS OF TECHNIQUES.

(Other Models Available In Various Price Ranges)



MODEL R-1 RADIOSURG

COLES CORPORATION

formerly ELECTRONIC SURGICAL EQUIPMENT CO., INC.

3212 Market Street PHILADELPHIA 4, PA., U.S.A.

ALL MODELS ON DEMONSTRATION AT A.D.A. MEETINGS

(Accepted by Council of Physical Medicine, A.M.A.)

Close-Up of Tooth Taken With Exakta "VX"

For Parallax-Free Dental Photography

New Model With Pre-Set Diaphragm

1952 EXAKTA—MODEL VX

35-mm. Single Lens Reflex Camera

For photographing conditions before and after treatment, cavities, inlays and bridgework, and for recording and for demonstrating oral treatment to patients. The indispensable aid of the progressive dentist! With f2.8 Zeiss Tessar "T" Coated Lens with

Pre-Set Diaphragm Control $269.50
Penta Prism Eye Level Reflex Viewfinder 50.00
Extension Tube Set 24.00
Microscope Adapter 29.50

FREE—Write Dept. 200 For Free Descriptive Booklet "C" on Camera & Accessories and Brochure On Close-Up Technique With Exakta.

EXAKTA CAMERA COMPANY

46 W. 29th St., New York 1, N. Y.

Exclusive Sales and Service Organization In U. S. A. For Ihagee Camera Works, Germany

Copyright 1951, Exakta Camera Company, Inc.

2

ITEMS

EVERY DENTIST USES

Accepted Council on Dental Therapeutics American Dental Association

TWO GOOD MIXERS

ZINC OXIDE, A.R-4 ozs. $1.00

EUGENOL, U.S.P. 1 oz. $1.00

REMEMBER—

YOUR DENTAL DEALER STOCKS THESE ITEMS

PRODUCTS OF

KING'S SPECIALTY COMPANY

FORT WAYNE, IND.

Retention that Lasts.. and Lasts..and LASTS!

JECTRON

REG. U.S. PAT. OFF.

The Best Fitting Denture Ever Made

Because of the superior molding accuracy of polystyrene resin—long recognized by researchers in the denture plastics field—a Jectron denture so closely reproduces the dimensions and detail of the cast that it fits the tissues snugly and evenly, all over. And because there is no "curing" involved in the molding process, it is free from curing-strain warpage or shrinkage, and *continues* to fit snugly and evenly, all over. That is why Jectron dentures rarely require post-insertion trimming, and retain their initial good retention indefinitely.

This is one of many Jectron advantages resulting from ten years of intensive research and development work, and more than a year of practical field-testing.

Perhaps a dental laboratory near you cooperated in these field tests, or has since equipped itself to construct these superbly-fitting, ultra-strong dentures. We will be glad to let you know upon request, and include the booklet "Jectron's 20 Keys to Denture Success". Just mail the coupon, or write.

THE TOLEDO DENTAL PRODUCTS COMPANY
Toledo 1, Ohio
Please send Jectron booklet and name of nearest Jectron laboratory.

Dr.....

Street Address.....

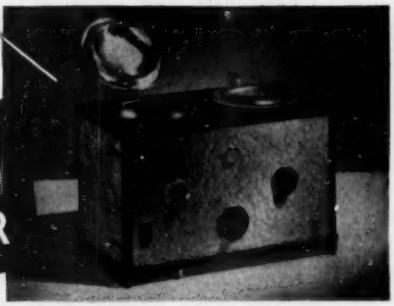
City.....Zone.....State.....

J52

HYDROCOLLOID CONDITIONED *Automatically*

HANAU

HYDROCOLLOID CONDITIONER

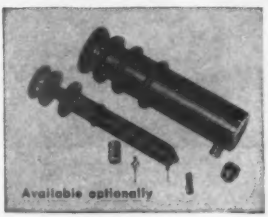


With the Hanau Electric Hydrocolloid Conditioner, each conditioning stage — boiling, storing, tempering — is performed under accurate, automatic control. Formerly, even the most painstaking methods gave no assurance of uniformly successful results.

Complete in itself, the Hanau Conditioner provides: a timer-controlled Quick-Boiler, for hydrocolloids in tubes or syringes; for automatic accuracy in the storing and tempering stages, two removable covered stainless steel receptacles controlled by individual thermostats over a range of 90° — 212° F.; a lifting rack for each receptacle — one for upright support and convenient handling of tubes and syringes, the other for immersing filled impression trays.

Thus, with this compact unit you not only prepare your requirements in a matter of minutes, but also you have properly conditioned hydrocolloid available for immediate use all day long.

HANAU HYDROCOLLOID SYRINGES *Feature Unique Air Release Valve*



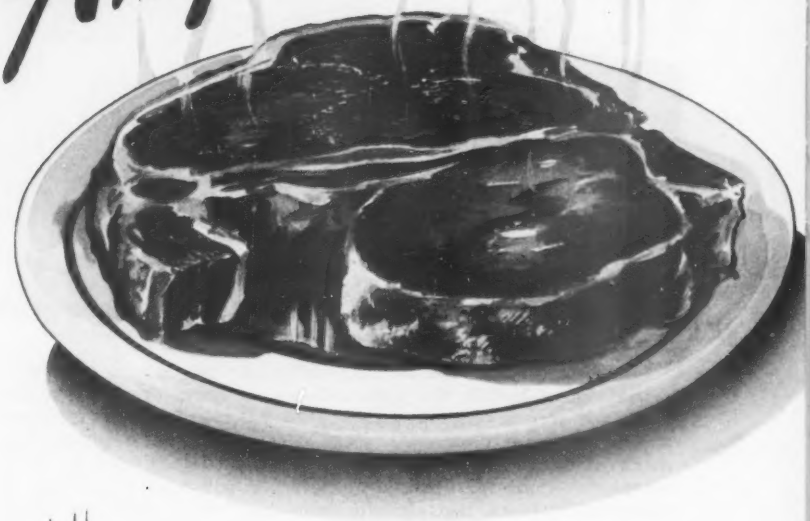
Moulded rubber covering permits immediate handling after removal from conditioning unit without discomfort to hands or patient, and insulates against temperature change of the hydrocolloid in the syringe. An air valve in the plunger releases trapped air before material is expelled, and prevents the plunger from "popping out" during boiling.

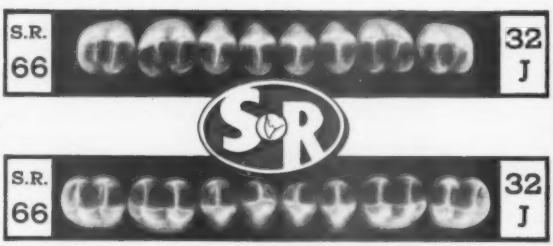
Two sizes meet every need: LARGE — for filling impression trays. SMALL — for applying material to prepared teeth.

Obtain full details from your dealer, or write Hanau for descriptive literature.

HANAU ENGINEERING CO., INC.
1233 Main St. • Buffalo 8, N. Y.

Anything ON THE MENU . . .





The Justi-Form Posterior, made of the new "S-R" plastic, is solvent resistant. Your dealer stocks include all 14 shades in 32 and 30 mm. sizes. 34 and 28 mm. will soon be available.

JUSTI *Products for Better*

NEW

. WITH THE JUSTI-FORM TRADE MARK POSTERIORS

NO, DOCTOR, we don't mean that every patient who wears "Justi-Forms" will be able to chew a steak.

In designing the new Justi-Form carvings, we simply did our best to incorporate certain features which members of the Profession suggested as being highly desirable:

DESIRED EFFECT	METHOD OF APPROACH
Cutting efficiency	*Sharply defined transverse ridges and cusps*
Grinding efficiency	*Mortar and pestle cusp action*
Balanced occlusion in a wide range of condyle inclinations and incisal guidance. Ease of articulation	*Carved on a broadly adjustable articulator. Ball and socket design of intercuspation*
Elimination of "locking" in centric	*Cusps and Fossae freed for slight lateral and protrusive freedom*
Reduced clogging	*Deep escape-gates*
Reduced stress on ridges	*Narrow bucco-lingual dimension*
Stability in protrusive movement	*Transverse ridges engage in protrusion*
Reduced thrust in lateral movement	*Low cusp height. Ball and socket balance. Engaged transverse ridges.*

YES, DOCTOR, we did our best . . . and we are reasonably sure that when your professional skill is aided by Justi-Forms, more and more denture patients will be able to order "*anything* on the menu."

Dentistry.....

Professional Service Dept.
H. D. JUSTI & SON, INC.
32nd & Spring Garden Sts., Phila. 4, Pa.

Please send me, without charge or obligation, your booklet on JUSTI-FORM posteriors

Dr. _____

Address _____

City _____ Zone _____ State _____

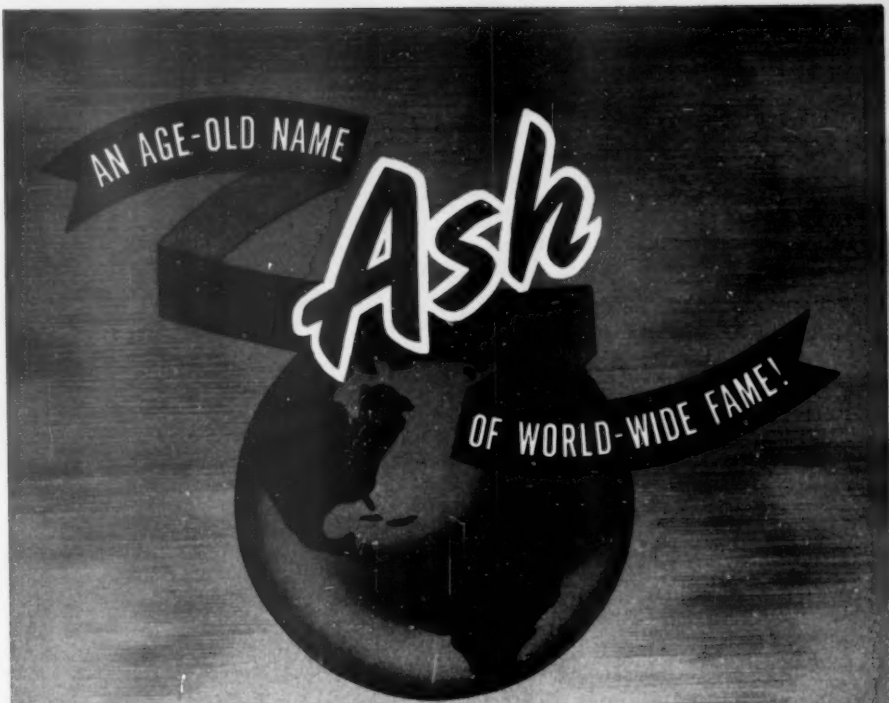
DENSENE "33"

GUARDS AGAINST DENTURE BREAKAGE!

STRONG

Densene 33 denture resin is preferred because it is strain-controlled for precision processing and service. For years its reliant strength has been acknowledged the most reliable safeguard against breakage—*for full and partial dentures!*

COSMOS DENTAL PRODUCTS, INC · 219 EAST 44th STREET · NEW YORK CITY



Ash
BURS . . .
FORCEPS . . .
INSTRUMENTS
IMPRESSION TRAYS . . .
ORTHODONTIC APPLIANCES

It is over 130 years ago since the House of Ash began building a world-wide reputation for quality performance in dental products never equalled in the industry.

Today, the House of Ash is a proud member of the Amalgamated Dental Group, which maintains research centers, factories, wholesale or retail organizations in all six continents.

And Ash Dental Products are still made of the finest materials, by master craftsmen, to the same high standards which have made the name Ash a byword wherever dentistry is practiced.

Take advantage of the opportunity to use only the finest—use Ash Dental Products.

Claudius Ash, Sons & Co., U.S.A., Inc.
ONE OF THE AMALGAMATED DENTAL GROUP OF COMPANIES
127-131 Coit Street Irvington 11, N. J.

Ash-the Hallmark of Quality Performance in Dental Products

On the job!

Our volunteer speakers are saving thousands of lives *today* . . . in factories and business offices . . . at neighborhood and civic centers . . . at social, fraternal and service group meetings all over this land . . . by showing people what they can do to protect themselves and their families against death from cancer.

In laboratories and hospitals, from coast to coast, our volunteer dollars are supporting hundreds of research and clinical projects that will save countless more lives *tomorrow*.

To find out what you yourself can do about cancer, or if you want us to arrange a special educational program for your neighbors, fellow-workers or friends, just telephone the American Cancer Society office nearest you or address your letter to "Cancer" in care of your local Post Office. One of our volunteer or staff workers will be on the job to help you.

American Cancer Society

INDEX TO ADVERTISEMENTS

May 1952

Abbott Laboratories A-17
Acralite Company, Inc. A-35
American Cabinet Company A-42
American Cancer Society A-72
American Dental Assn. A-30, A-31
American Sterilizer Co. A-11
Ash, Claudius and Sons A-71
Astra Pharmaceutical Products Co. A-18
Austenal Laboratories A-48, A-49

Baker and Company A-26
Blakiston Company A-34
Bristol Myers Co. A-16, A-62
Burton Mfg. Co. A-14

Caulk Co., L. D. A-64
Childs Manufacturing Co. A-9
Church and Dwight A-28
Classified Advertising A-22, A-23, A-24
Coe Laboratories A-13
Coles Corporation A-6
Columbia Dentoform Corp. A-10
Columbus Dental Mfg. Co. A-29
Colwell Publishing A-50
Cook-Waite Laboratories A-2
Corega Chemical Co. A-51
Cosmos Dental Products, Inc. A-70
Crescent Dental Mfg. Co. A-50

Dental Perfection Co. A-61
Dentists' Supply Co., of N. Y. ..... 2nd Cover
4th Cover

Exakta Camera Corp. A-65

FR Corporation A-8

Getz Corp., William A-55
Graham Chemical Co. A-6

Hanau Engineering Co. A-67
Handy and Harman, Dee Gold A-1
Howard Uniforms A-58

International Nickel A-25

Jelenko and Co., J. F. A-43
Johnson and Johnson A-60
Justi and Son, H. D. A-68, A-69

Kerr Manufacturing Co. A-54
King's Specialty A-65

Lauer Metal Shop A-24
Lea and Febiger A-58
Lippincott Co., J. B. A-12

Master Appliance Mfg. Co. A-10
Medical Protective Co. A-10
Merck and Co., Inc. A-39
Mosby and Co., C. V. A-27
Moyer Co., J. Bird A-40

National Dairy Council A-7
Ney Co., J. M. A-5
Novocol A-32

Oral B. Company A-57

Parke Davis and Co. A-41
Pfingst and Co. A-47
Physicians Casualty & Health Assn. A-37
Professional Budget Plan A-4
Professional Printing Co. A-26
Pycopé, Inc. A-33

Ransom and Randolph Co. A-56
Rinn X-Ray Products Co. A-46
Ritter Co. A-59
Rota-Seat, Inc. A-15
Rower Dental Mfg. Co. A-19

Saunders Co., W. B. A-20, A-21
Standard Dental Products Co. A-36
Squibb and Sons A-63

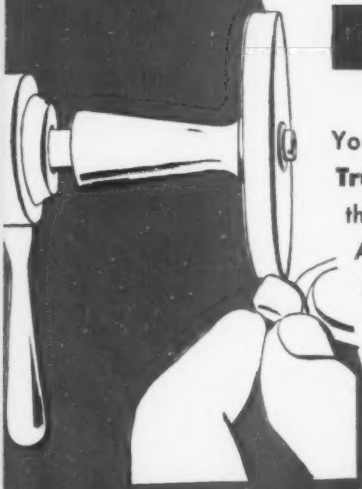
Ticonium A-38
Toledo Dental Products Co. A-66

Union Broach A-37
U. S. Savings Bonds A-3

Wernet Dental Mfg. Co. A-44, A-45
White Dental Mfg. Co., The S. S. A-52, A-53

it's easy to alter

trubyte Bioform teeth



You can change the form of **Trubyte Bioform Teeth** without their edges chipping or flaking. And you can repolish the teeth in a matter of minutes with only a rag wheel and pumice. Glazing is not necessary after grinding.

•

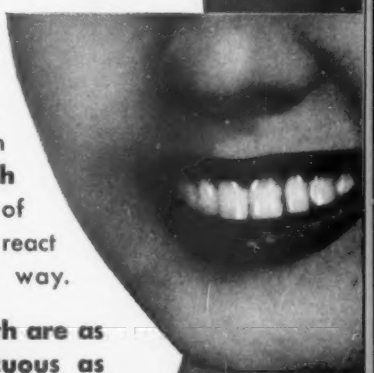
NEW IN EVERY WAY

trubyte Bioform® teeth

the first "*vacuum fired* porcelain" teeth

Erosions and decalcifications can be simulated in **Trubyte Bioform Teeth**. Doing so requires very little time.

The increased strength and density of **Trubyte Bioform Teeth** are only two of the advantages attributable to vacuum firing. **Trubyte Bioform Teeth** are more like the structure of healthy natural teeth . . . and react to light in much the same way.



Only the finest natural teeth are as lifelike and as inconspicuous as TRUBYTE BIOFORM TEETH.